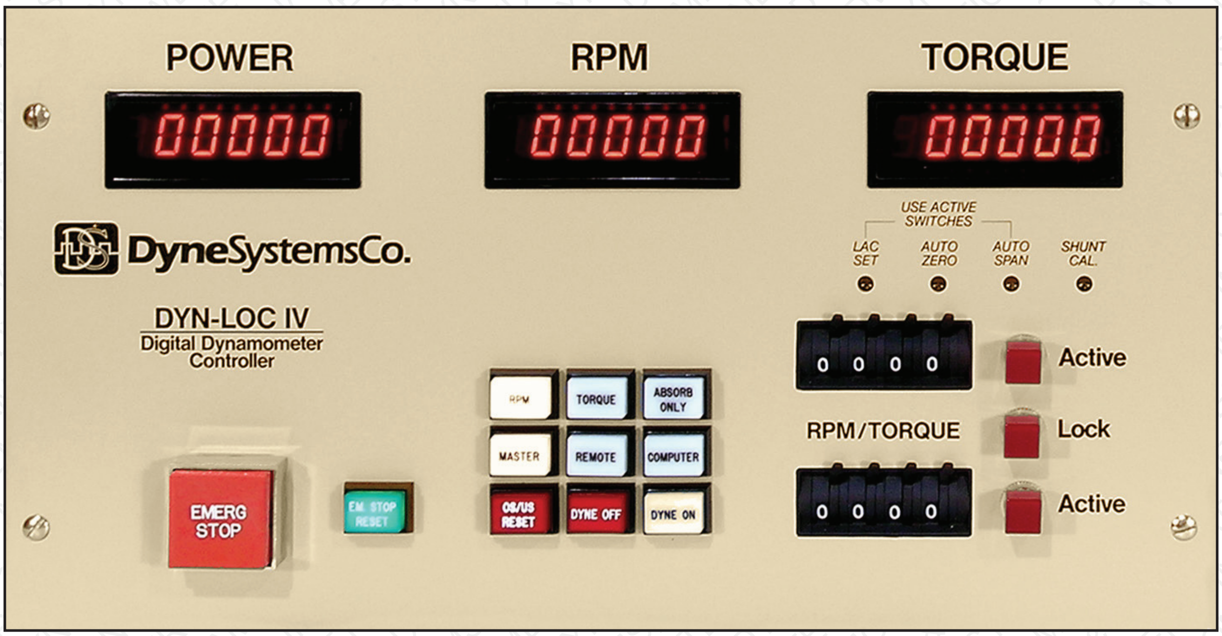
DyneSystems, Inc.
Midwest & Dynamatic
Dynamometers



Dyn-Loc IV

USER MANUAL

revised July 2001

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Revision History

Item #: MAN-DL4-00001

May, 2001
Initial Version

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Chapter 1

Introduction

The Dyn-Loc master control unit is the brains of a dynamometer control system. It provides closed loop digital performance in controlling RPM or torque.

This Master Control Unit is designed for use as a complete eddy-current dyno control and dyno fields up to 16 Amp rating. For higher field current ratings, a separate field amplifier module is available for up to 100 Amp fields, up to 480V.

The Dyn-Loc IV is also used as the operators' interface and closed loop controller for AC Vector and DC (motoring/loading type) dynamometers. The AC Vector or DC power amplifier is used as a current/torque function block in the control system.

1.0 Audience

Dyne Systems assumes the following regarding the users of this product.

- Personnel responsible for *equipment use* have knowledge of dynamometers, engines/motors, instrumentation related to the testing required, and test procedures required.
- Personnel responsible for electrical connections are registered electricians, with an understanding of general power and signal wiring, conduit segregation, and the related devices.
- Personnel responsible for the PLC logic have experience in all the above, plus PLC programming/use and interlocking concepts.

2.0 Features

There have been three revisions to this unit over the years, the Dyn-Loc IV/186 being the latest. It provides the following new features.

- Data acquisition rates up to 200 hz via special PAL frequency measurement methods.
- 10 hz display update rate, averaging options to eight seconds.
- RS232 port baud rates up to 115,200.
- Two wire RS232 operation at any baud rate with no hardware handshake needed.
- Extended functions assigned to multiple front panel push-button combinations.
- Additional configurability via DIP switches / jumpers.
- EEPROM setup storage.
- Extended functionality for four quadrant (motoring) dynamometers.
- ROM resident EPA road load functions and engine/vehicle inertia simulation (optional).
- Windows NT-based terminal emulation software for parameter download or user setup (optional).

3.0 Location Requirements

For safe and reliable operation, check that:

- All electrical and mechanical connections are secure and in compliance with their respective schematics in the *Drawings and Schematics* chapter of this manual.
- The system is installed away from any liquids or condensation.
- The system is safe from physical shock and jarring.

4.0 Safety

To prevent physical injury, follow basic safety precautions when installing, operating, and maintaining this equipment.

To ensure safe and reliable operation:

- Follow all instructions in this manual.
- Always cancel power to this equipment before removing the cabinet lid.
- Obey all safety signs on the equipment and in this manual.
- Use proper point-of-operation safeguarding.

For these and other safety precautions, refer to the American National Standards Institute (ANSI) or the Occupational Safety and Health Administration (OSHA).

4.1 Electrocution Hazard

This product and associated components are electrically energized. Electric shock may cause serious injury or death. Always disconnect line voltage before servicing the unit or any associated components.

⚠ ***DANGER:*** Disconnect all power before removing the cabinet lid or servicing the unit and any associated components. Failure to do so may result in serious injury or death.

Only certified electricians can install this equipment. Unskilled or unauthorized personnel attempting to install this equipment may cause equipment damage, serious injury, or death.

4.2 Electrostatic Discharge Damage

Electrostatic discharge (ESD) can damage sensitive microchips and semiconductors on circuit boards in the PAU cabinet and other internal components. Always wear some manner of ESD-grounding device, such as a wrist strap, when handling internal components.

CAUTION: Failure to observe ESD-grounding precautions may damage sensitive components.

4.3 Safety Signs and Symbols

4.3.1 System Safety Labels

This test system displays various labels and signs highlighting and explaining caution and danger areas. Obey these signs when operating this machinery. These signs comply with the American National Standards Institute (ANSI Z535) and the Occupational Safety and Health Administration (OSHA 1910.145). The signs depict one of the following conditions:

Danger

Danger signs and labels indicate imminently hazardous situations resulting in death or serious injury if not avoided.

Warning

Warning signs indicate potentially hazardous situations resulting in death or serious injury if not avoided.

Caution

Caution signs and labels indicate potentially hazardous situations resulting in minor or moderate injury if not avoided.

4.3.2 Documentation Conventions

Some parts of this manual describe information in the form of notes, cautions, and danger signs. Refer to this section for descriptions of these callouts.

Note: Notes provide supplemental information related to a procedure.

CAUTION: Cautions with no safety symbol indicate conditions that may cause equipment damage, or data loss if instructions are not followed exactly as given.

⚠ ***CAUTION:*** Cautions displaying the safety symbol indicate conditions that may cause physical injury as well as equipment damage, or data loss if instructions are not followed exactly as given.

⚠ ***DANGER:*** Dangers indicate conditions that may cause death or serious injury if instructions are not followed exactly as given.

Chapter 2

Specifications

The Dyn-Loc IV is rated for 277 Vac single-phase line input, which yields a maximum of 250 VDC output with ratings of 16 Adc. This unit requires an isolation transformer(s), rated for the appropriate voltage and current being handled, for proper operation. This chapter describes the specification of the Dyn-Loc IV.

1.0 Unit Specifications

1.1 Location

For safe and reliable Dyn-Loc IV operation, check the following.

- All electrical connections are secure and in compliance with the appropriate schematic in the *Drawings and Schematics* chapter.
- The unit is installed away from any liquids or condensation.
- The unit is safe from physical shock and jarring.

1.2 Unit Specifications

1.2.1 Mechanical

- 19" x 8.75" x 13" rack/desk/pedestal mounted basic building block.
- Common to both eddy current and four quadrant versions and remote units.

1.2.2 Power Supply Requirements

- 120/240 VAC, 1 phase for control power.
- 240 VAC, 1 phase (phase matched to control power) for field coil power.
- Use of isolation transformer recommended for field coil power.

1.2.3 RPM Transducer Requirement

- 60 (or multiples of 60) pulses per revolution.
- Standard magnetic pickup used with 60 tooth gear.
- Digital encoder.

1.2.4 Load Feedback/Transducer Requirements

- Stain gauge type load cell, 2-3 mV/V (+9VDC excitation and signal conditioner provided).
- Analog feedback (±1 to 10 VDC).

1.2.5 Connections

- All signal level I/O via subminiature D or MS connector.
- Exception: H_20 Interlock is the signal level, and it is connected via the barrier strip.
- All power I/O by 30 Amp, 300 volt barrier strip.

1.2.6 Control Modes

- All dynamometers.
  - RPM or torque with digital setpoint entry.
  - Inertia simulation.
- Chassis dynamometers (optional).
  - Road load mode configurable via serial port command subset.
  - Coast down mode related to road load mode.

1.2.7 Control Origin

- Master/remote/computer with full digital control and instrumentation.

1.2.8 Reference Setpoint Entry

- Manually by digital lever wheel switches.
- Computer by 16 bit parallel BCD data entry.
- Computer by RS232 data entry, ASCII keywords.
- Computer by RS232 data entry, BINARY.
- Digital reference based on .005%, 1 Mhz crystal oscillator.
- Analog reference input, 0 - 10 VDC (scalable).

1.2.9 LAC Entry (Rate of Change Setpoint)

- Computer by binary 8-bit parallel data entry.
- Computer by RS232 data entry, ASCII keywords.
- Computer by RS232 data entry, BINARY.
- Manually by front panel digital lever wheel switches and LAC push button.
- Range of 39 - 5,000 units per seconds, standard. Dip switch selectable x1/2 and x1/10 ranges.

1.2.10 Control Regulation and Drift

- RPM – 0 RPM long term, ±RPM short term.
- Torque – 0 ft-# long term, ±LSD short term.

1.2.11 Instrumentation Features

- Microcomputer controlled – 80C186 with 80C187 coprocessor option for road load.
- 10 hz display update rate.
- RPM/torque/power displays to 32,767 units.
- Selectable software averaging via DIP switches (8 to 1 range).
- Can display averaged, 10 hz or 200 hz data.
- Three selectable torque/power decimal places via DIP switches.
- Three selectable RPM decimal places via CPU PCB jumpers.
- Units are horsepower, RPM, and pound-feet standard. Metric units DIP switch selectable.
- Auto span by front panel PB, no potentiometer adjustments.

- Auto zero by front panel PB, no potentiometer adjustments.
- ± shunt cal by front panel PB.
- Torque linearity – .05% of span calibration point.
- Power accuracy – 25 ppm or 1 digit.
- Load cell instrumentation temperature stability of 25 ppm per deg. C.
- Analog RPM and torque output via rear panel BNC connectors.

1.2.12 Eddy-Current Power Amplifier

- Integral 16 amp., 250 VDC, wide bandwidth, 4SCR regenerative amp (bidir. field forcing).
- Optically isolated from digital control circuits.

1.2.13 Overspeed/Underspeed Safety

- Overspeed trip at overspeed set point +2 RPM.
  - Set by 2 digit overspeed switch.
  - 100 RPM resolution.
- Underspeed trip (defeatable) at RPM loss (at less than 2 RPM) during Dyne On.
- OS Relay driver triac.
  - NO or NC operation (DIP switch).
  - 120 VAC, 0.1 A maximum rating.
- Any trip causes.
  - User adjustable braking (defeatable) on eddy current dynamometer.
  - Power off and dynamic braking on four quadrant dyno.
  - Changing of state of OS triac.

1.2.14 Data Acquisition

- Full duplex RS232 port.
  - RPM, torque, and power data in ASCII or binary.
  - Status work in ASCII or binary.
- Parallel port – 16 bit binary RPM or signed torque data, simple three wire handshake.

1.2.15 Computer Control

- Parallel port.
  - Digital entry or RPM or torque setpoint.
  - Digital LAC entry.
  - RPM, torque, Dyne On/Off, and Em. Stop mode control by bit sets, filtered edge control.
  - 16 status bits for confirmation of control and monitoring of operation.
- RS232 Port – Same capabilities as parallel port.

1.2.16 Remote Control Unit

- Identical to master unit in appearance.
- Duplicates most front panel control functions of MASTER.
  - Speed, torque, and power displays.
  - Mode selection.
  - Setpoint entry.
  - Emergency stop.
  - Dyne ON/OFF.
  - Fault trip reset.
- Requires 120 VAC @ 0.1 A.
- Interconnection by 37 conductor shielded round ribbon cable, sub D connectors.
- Rack or floor stand mounting options.

1.2.17 DC or AC Four Quadrant Motoring Controls

- Uses the master control unit above, plus an external static power amplifier.
  - Wall mounted units to 120 HP @ 500 VDC or 60 HP @ 250 VDC.
  - Floor mounted above these sizes.
- Requires 3 phase 240 VAC (250 V armature) or 480 VAC (500 V armature).
- Isolation transformer recommended.
- Specifications identical to the eddy current unit plus the following.
  - Motoring/loading capability (in either direction).
  - Power saving 3 phase power regeneration during loading.
- Automatic switching between loading/motoring occurs from error signal polarity control.
- Automatic soft transition to setpoint when dyne is turned on (engine off or running).
- Package includes a zero speed directional encoder (speed sensor).

1.2.18 Throttle Controller Option

- Master unit has a dedicated interface to Dyne Systems Company, LLC.'s DTC-1 Digital Throttle Control, which provides simultaneous control of RPM or torque with digital accuracy.

Chapter 3

Installation

1.0 Before You Begin

Visually inspect all parts and cross reference all items with the packing slip to ensure that all components are accounted for and undamaged.

2.0 Signal Wiring Requirements

Enclose all signal circuits in separate conduit from the AC and DC power wiring. Any other wiring that creates high frequency noise, such as thermocouples, motor switches etc., must also be separated in this manner.

The excellent performance possible with the Dyn-Loc IV controls are dependent on a good signal to pulse noise ratio and physical/electrical isolation from any power sources related to pulse noise generation (including earth grounds). All signal wiring must be shielded and run in separate conduit from any power wiring. Good spatial separation must be maintained from SCR wiring or sources connected to any switching type power amplifiers.

Shield connections must be made to Dyn-Loc common and adequately isolated from any possible earth grounds. Insure that shield connections are carried through to the device location.

CAUTION: Do not connect shield at the device location. If the earth ground is unavoidable, Dyn-Loc IV wiring must be connected in only one place.

2.1 MS Connectors General Information

Multi-conductor cable should be 20-22 gauge, fine stranded, foil type shielding (with drain wire) with strong insulating jacket. Avoid nicking wires when stripping away jacket

and shield. All connections must be fully inserted and show good solder flow. Avoid excessive solder wicking. Strain relief of connections with shrink tubing is desirable. Clean soldered area with flux cleaner and inspect for shorts, etc. Use shrink tubing to cover the area where the jacket terminates. Use the MS strain relief boot. Follow the rear panel connection labeling.

2.1.1 Load Cell Feedback MS Connector

This requires a 4 conductor cable. It is desirable to minimize the number of series connections for this device. An unbroken cable run from the load cell to the Dyn-Loc is ideal. Connect the shield drain wire to the excitation common (Pin D) at the back panel connector. Do *not* connect the shield at the load cell.

2.1.2 RPM Feedback MS Connector

Eddy current dynamometers should use an Electro 3030 Magnetic pickup (Mag. PU) or equivalent transducer. This transducer requires a 2 conductor cable. The transducer air gap should be approximately 0.010". 60-tooth gear runout should be held to less than ±0.020". Connect the shield drain wire to the logic common (pin C) at MS connector. Four quadrant (DC or AC motoring) dynos use a digital, directional RPM transducer supplied. The air gap should be 0.040" ±0.005. If the transducer cable is to be extended no longer than 35 feet total length, use a low capacity type cable. Mag PU signals should be checked at a start-up under conditions of increasing dynamometer field current for possible demagnetization of pickup magnet due to field leakage flux. If the Mag PU signal decreases significantly as field current increases, de-energize the control and reverse the field conductor connections. Mark wires F1 and F2. The acceptable Mag PU signal level is 2 - 25 VRMS over operating range.

2.2 Sub-D type Connector Wiring and Part Numbers

2.2.1 General

These connectors are designed for use with a round cable, 20-22 gauge, fine stranded, foil shielded, drain wire, and jacketed. Before inserting any pins into the connector, slip on the back shell boot that best fits your cable. Do not put any strain on the wires. Use 3M plastic/plated back shell (or equivalent) with retaining screws. Note cable 45 degree exit angle desired before installing the backshell. Follow the pin-out listings and drawings. Female pins are Amp #205090-1, and male pins are Amp #205089-1.

Remote OCS Ribbon Connector

Use 37 PIN, male, amp #205210-1 (Dyn-Loc end).

If the 37 pin crimp-on connectors are used, care must be taken to orient ribbon properly before crimping or shorts will occur between conductors. At the end where the shield is to be connected (to logic Common), extend the ribbon beyond connector 3" for crimping. This provides for a connection to pin 23 (common). Cut the adjacent wires. Connect the shield to pin 23 by isolating the ribbon wire to that pin and soldering it to shield drain wire. Fold into the backshell. Ensure no strain on shield connection. Do not ground the shield. Use a 3M or equivalent backshell with retaining screws.

Parallel Control Connector

Use 37 pin, female, amp #205209-1.

Connect the shield to the logic common at the Dyn-Loc.

Parallel Data Connector

Use 25 pin, female, amp #205207-1.

Connect the shield to the logic common at the Dyn-Loc.

Four Quad I/O Connector

Use 15 pin, male, amp #205206-1.

If the connector is being used for a static DC Dyne control, install jumper 11 to 13. Connect the shield to the Dyn-Loc common at pin 11 by trimming part of the shield wires off for a good fit into the crimp pin and jumper wire. Do not connect the shield at the other end.

Serial I/O Connector

Use 9 pin, female, amp #205203-1.

Use a 4 conductor shielded cable, 22 gauge. The drain wire may be used for the common conductor. A 2-wire hookup may be used (Rx/Tx only), but in this case, CTS and RTS must be tied together at the Dyn-Loc end. Use a logic common connection.

Throttle Control I/O Connector

Use 25 pin, male, amp #205208-1.

Connect the shield to the logic common at the Dyn-Loc.

3.0 Barrier Strip Connections

Water Interlock Connections Labelled H2O and I.L.

These connections are intended for unpowered normally closed contacts (all in series), indicating safe to run conditions such as Water Temperature, Water Pressure, or Water Flow.

CAUTION: Do not connect a voltage source (especially 115 VAC) or ground to these terminals.

The terminal labelled H2O has a +5 VDC open circuit voltage on it with respect to the I.L. terminal. The short circuit current is limited to 10 to 25 mA. If this voltage/current level does not provide for reliable operation with the existing safety contacts, ask Dyne Systems for help. One option is adding in the Dyne Systems OS/US – EMS module where the open circuit voltage is 120 VAC and the short circuit current is 10mA. It also adds other benefits such as providing a logically OR’ed output for the over/under speed and Emergency Stop fault circuits.

Connecting these two terminals together through your external safety device will enable normal eddy current operation. Opening this circuit after one second will inhibit the Dyne On condition or cause Dyne Off if the dynamometer is on.

> ***Note:*** Dress away from all power wiring. Although the connection is to the barrier strip, this is signal wiring. If the wire is shielded, connect the shield to Terminal 1 (H2O).

3.1 Power Wiring General Information

Use an insulated barrel and locking spade lugs on all connections. The wire should fit into the barrel snugly before crimping. Use an indent crimping tool with a circular lug retainer. The barrier strip screws are UNC 6-32 size.

3.1.1 GND

Connect a 14-gauge stranded green wire to the GND and to a good system ground. This is a safety ground to avoid internal power shorts to case and does not tie into any internal circuitry.

3.1.2 L1-L2

This is up to 277 VAC power input to the SCR power amplifier. Use the proper gauge and a fine stranded wire. An isolation transformer is required. Multiple control installations must use isolation transformers on each control (preferably tied back to a supply bus) to eliminate undesirable SCR control interactions. Refer to F1-F2 for additional information on noise content. This power must be in phase sync with L3-L4. L1 and L2 are not wired if you are using a four-quadrant AC or DC drive.

3.1.3 L3-L4

This is 120/240 VAC ±10% power input for control circuit power supplies. Input voltage is switch selectable on main PCB and factory set for 120V. The current drain is 0.2A. Use 14-16 gauge fine stranded wires. This power must be in phase sync with L1-L2. If the supply bus is 120 or 240 VAC, it may be connected directly to L3-L4. If not, use a 100 VA isolation transformer to step down the supply bus to 120 VAC for L3-L4.

> ***Note:*** If L1-L2 and L3-L4 are isolated from one another, this provides redundant isolation which reduces SCR pulse noise in the control circuits. This enhances controller and connected computer systems reliability.

3.1.4 F1-F2

This is the eddy current field power output. Use the proper gauge fine stranded wire. These wires carry power with a significantly high frequency content due to the switching characteristic of 4SCR amplifiers. Keep this separated from all signal wiring. F1 and F2 are not wired if you are using a four-quadrant AC or DC drive.

3.1.5 OS/US

This is a zero point firing triac switch (Motorola MOC3031 or equivalent. The rating is 120VAC@50 ma. maximum. The triac may be dip switch selected on OS/US PCB (DS255) to be NO or NC for safe conditions and is meant to drive relays such as P&B KUP type. Do not use this on solenoids or larger relays. Wire as you would a relay contact, in series with the load relay.

- 120VAC "hot" to left OS/US terminal.
- 120VAC "neutral" to one side of relay coil.
- Right OS/US terminal to other side of relay coil.

4.0 Notes on the Remote Control Unit

Dyne Systems Company, LLC can provide a slope front pedestal mounting, or a pedestal mount for the standard enclosure. Maintain at least five feet separation from vicinity of the engine for ignition type engines to prevent ignition noise interference in the unit.

4.1 Wiring the Remote Unit

- A 37 conductor round, shielded cable should be used for interconnection. Connection is to be made to the same pin numbers at each end, unless special functions are being provided (see our job specifications), shield to logic common. Avoid earth ground connections, any grounding in the system should be at the master unit logic common.
- The shielded cable should be treated as low signal level wiring and so be isolated from all but signal wiring. Conduit must be carried up close to the unit to provide shielding against cell noise sources.
- The 120VAC power for the unit may be obtained from any clean source; the unit requires only 50VA of power.
- Refer to the "Remote OCS Ribbon Connector" section if you need assistance.

Chapter 4

Display Set-Up and Maintenance

1.0 Before You Begin

- Do not proceed with this chapter until the Dyn-Loc has been installed according to the guidelines in the installation section of this manual.
- Do not proceed with the Torque Display Calibration portion of this chapter without allowing a minimum of 15 minutes warm-up from the time the AC power is applied.

2.0 Overview

The Dyn-Loc IV display system is microcomputer-based. This provides flexibility in calibration range, data averaging, and data acquisition.

- Speed data is entirely digital. There are no a/d or d/a converters in the system.
- Torque data is acquired from a high quality instrumentation amplifier providing digitally controlled gain for the strain-gauge over a range of 18 to 750 in 16,000 discrete steps and digitally controlled zero offset over a range of ±12,000 units. Temperature stability is typically ±25 ppm/deg C.
- Power is calculated to 32 bits, uncorrected for ambient engine conditions.
- PAL devices are used to digitally measure the speed or torque channels at up to 200 times per second, allowing for fast data acquisition and therefore fast calibration.

3.0 Speed Display Decimal Place

For most applications, the speed display will not require a fractional component. If one is desired, the unit must be opened up and jumpers 13 and 14 on the DS503 CPU board located. JP13 and 14 are on the bottom center of the board. They control the speed dp according to the chart below.

JP14	JP13	Speed Display
OUT	OUT	00000
OUT	IN	0000.0
IN	OUT	000.00
IN	IN	00.000

4.0 Speed Display Averaging

The microprocessor displays a moving window average of the latest N seconds of 10hz speed data. The user has the option of averaging the last 1, 2, or 4 seconds of speed data. This setting is controlled by two DIP switches, one of which is accessible from the front panel. The other must be changed by opening the unit. The primary setting is switch #8 under the TORQUE display bezel. To access this switch, use a fingernail or soft slim object to pry off the bezel. The secondary setting is on the DS503 CPU board, the switch block is designated SW1 on the silk-screen (the speed averaging doubler) switch #4.

TQ Display Switch #8	DS503 SW1/ Switch#4	Seconds Speed Averaging
OFF	OFF	1
ON	OFF	2
OFF	ON	2
ON	ON	4

5.0 Torque Display Decimal Place

The torque display fractional component is easily set from the front panel. To access this setting, use a fingernail or soft slim object to pry off the TORQUE bezel. Set switches #4 and 5 as displayed below. The power decimal point matches the torque decimal point.

TQ Display Switch #5	TQ Display Switch #4	TQ Display
OFF	OFF	00000
OFF	ON	0000.0
ON	OFF	000.00
ON	ON	00.000

6.0 Displaying Un-Averaged Data

To observe the raw or un-averaged data being read by the microprocessor from the PAL system, open the unit and locate the SW1 switch block on the DS503B CPU board. The 10hz and 200hz raw data can be made to appear on the displays as indicated in the table below. Note: The 200 hz data is displayed at a 10hz display update rate.

DS503 SW1/ Switch #2	DS503 SW1/ Switch #3	Data Display Override
OFF	OFF	NONE
OFF	ON	200 hz
ON	OFF	10 hz
ON	ON	ILLEGAL

7.0 Zeroing the Torque Display

Refer to the HELP number descriptions for HELP xxxx messages appearing on the display during this calibration process.

Assuming the display shows an offset of at least 1 Least Significant Digit (LSD) zeroing the offset may be performed as follows.

Complete a Zero at the beginning of the work day. See the Shunt Cal section for another daily suggestion. Note any large changes as they may be an indication of malfunction in the load cell or signal conditioner circuits.

1 Ensure the dynamometer is free of external forces and the load cell mounting configuration prevents application of any lateral forces to load cell.

2. Exert a temporary force on the dyne in the loading direction while observing the torque display polarity. Reverse leads B and C on the load cell MS connector if the torque sign is not positive for engine loading direction.
3. Press the Auto Zero button for ½ second using a pencil tip or small soft device. The display flashes and steps rapidly to zero. The computer needs a 0 ±2 reading. This process may take from 2 to 10 seconds. Perform the zero a second time if the first zero leaves a non-zero low value. An extremely large zero offset (>20,000 counts) may prevent a complete AZ in the allowed time period. In this case, the data will be rejected and previous settings will retained. It may be necessary to temporarily balance out part of the offset in order to obtain a zero, then remove the balance weights and complete the zero process. Subsequent zero procedures should not require this manipulation.
4. Repeat the ZERO and SPAN operations at least once to check for interaction. Data from this process is stored in non-volatile memory so calibration need not be repeated after power ON/OFF/ON cycling. Be aware that zero data will be lost if the system defaults are set. Allow 15 minutes for warm up in all cases then check zero and span to satisfy yourself that it is repeatable.

8.0 Spanning the Torque Display

To span the torque display, apply the calibrating load to the dynamometer (preferably equal to the maximum for the application) preventing motion or contact with other surfaces. Assuming the calibration is in error by at least ±2 least significant digit, a span adjustment may be performed as indicated below.

Check the Span periodically or when the shunt cal reading changes drastically. Note any large changes as they may be an indication of malfunction in the load cell or signal conditioner circuits.

1. Set in the desired torque reading corresponding to the weights used on the dynamometer multiplied by the length of the calibrating arm using the RPM/TORQUE digital switches which are presently ACTIVE. Take into account the torque decimal point and the desired torque units. Refer to the Power Display Setup section if you need additional information.
2. Press Auto Span for ½ second. The display flashes and steps rapidly to the same reading set in on the digital switches.
3. If it is necessary to Span to a value higher than can be input on the leverwheel switches, position 1 of the dip switch under the Torque display can be used to add 10,000 to the value set on the leverwheel switches.
4. Repeat the ZERO and SPAN operations at least once to check for interaction. Data from this process is stored in non-volatile memory so calibration need not be repeated after power ON/OFF/ON cycling. Be aware that span data will be lost if the system defaults are set. Allow 15 minutes for warm up in all cases, then check zero and span to satisfy yourself that it is repeatable. Apply approximately half the previous load to the dyne and check for acceptable linearity. Signal conditioner linearity spec is ±.05% FS max.

If an extremely large span change is necessary, the computer may oscillate around the desired AS point. If so, it will reject the settings and revert to the previous readings. In this case, it is necessary to set the digital switches midway to the desired calibration for the first Span attempt, then to the true calibration point for the second attempt using the weights based upon the true AS point.

9.0 Using the Shunt Cal Button

Perform the Zero/Span process before attempting to use the Shunt Cal button.

Shunt Cal is a repeatable unbalance of the resistor bridge which makes up all load cells. It is intended to be used as a means of checking calibration and as a means of actually calibrating without hanging weights.

Perform the Zero/Span process before attempting to use the Shunt Cal. button.

1. Perform an accurate calibration using weights, then remove the weights.
2. Push the SHUNT CAL PB (hold it until the display stops changing).
3. Record the value on the front panel display.
4. Repeat steps 2 and 3 for the other direction.
5. If you need to check the instrumentation, check the Shunt Cal against the previously recorded value. If the check reveals a difference as follows, span the control to the original shunt cal reading. Set the desired shunt cal on the active leverwheel switches. Push AUTO SPAN and SHUNT CAL simultaneously. The control will span in the direction last read to the shunt cal value.

10.0 Power Display Setup

The following switch settings will be partially or completely overridden if the display unit's commands are used to set the system for chassis dyno/road load operation.

The power display can be set to use several different sets of units for its calculation. To access this setting, use a fingernail or soft slim object to pry off the TORQUE bezel. Set switches 6 and 7 as indicated below.

TQ Display Switch #6	TQ Display Switch #7	TQ Units	Power Units
OFF	OFF	Pound Feet	Horsepower
OFF	ON	Pound Inches	Horsepower
ON	OFF	Newton Meters	kiloWatts (kW)
ON	ON	Newton Meters	Horsepower

11.0 Setting System Defaults

WARNING: Setting the system defaults completely resets the system. Any configuration accessible strictly via RS232 port will also be erased.

The entire CPU system can be reset to factory defaults using the following procedure.

1. Use a fingernail or soft, slim object to pry off the POWER bezel.
2. Set switch #4 to ON.
3. Cycle the AC POWER or issue the REBOOT command from a terminal.
4. Short the JP5 on the DS503B CPU board on the upper front corner labeled RESET.
5. Set switch #4 to OFF.

CAUTION: Failure to set switch #4 back to off will cause a reset to the system defaults every time the AC power is cycled.

12.0 Push Button Functions

The firmware in the Dyn-Loc IV/186 assigns a function to every possible combination of one or two front panel push buttons. The following table displays all combinations and will therefore duplicate the basic single button functions.

The special push button functions are primarily for troubleshooting, however, some contain some useful functions for normal operation such as querying the current LAC setting from the front panel.

Push Button Combination	Result
LAC SET	Set MAN mode LAC from lever wheels.
AUTO ZERO	Zero the TQ display
AUTO SPAN	Span TQ display from lever wheels
SHUNT CAL	Activate FET shunt (alternating sign) of load cell bridge
AUTO SPAN + SHUNT CAL	Span TQ display using FET shunt
LAC SET + AUTO ZERO	Show AZ D2A setting on TQ display
LAC ST + AUTO SPAN	Show AS D2A setting on TQ display
LAC SET + SHUNT CAL	Show firmware revision on display

Push Button Combination	Result
AUTO ZERO + SHUNT CAL	Memory Test (any button to stop)
AUTO ZERO + AUTO SPAN	Reboot

Use the following table to determine the effect of the LAC SET push button according to the lever wheel settings.

Lever Wheel Setting	Action
0	Display current setting
1	Set to RAPID
2	Calibrate REF CLOCK (always done at bootup)
3	Exit from REF CLOCK calibration
4	Display crash recovery counter
5 - 38	Invalid LAC value (HELP 0 39-5000)
39 - 5000	Valid LAC settings in controlled variable units/second
5001 - 9999	Invalid LAC value (HELP 0 39-5000)

Note: Certain valid leverwheel settings will round to valid LAC settings.

Chapter 5

Dynamometer Startup Procedure

Before You Begin: Do not start the dynamometer until the Dyn-Loc has been installed and set up according to the instructions in this manual.

1.0 Wiring and Conduit Checks

Use the following tips when checking the wiring and conduit.

- **For common wiring raceway/conduit for signal and power wiring**, all power must be in separate raceway from signals.
- **Do not tie the Dyn-Loc L1-L2 in parallel with L3-L4!** The L3-L4 must be taken from a clean AC line in phase with L1-L2.
- **Earth ground on magnetic pickup (Mag. PU) and/or load cell shields.** All Dyn-Loc circuits are floating with respect to GND. Shields tie to Dyn-Loc common at connector in question.
- **Multiple series connections and/or cold solder in load cell wires.** These faults increase the likelihood of loose connections, thermal signals, and higher noise susceptibility in the torque transducer loop. This will show up as increased drift and intermittent torque display problems.
- **Several Dyne Controls' SCR amplifiers tied to same power lines.** Without isolation transformers, this set up may seem to work in some instances, but it will produce seemingly unpredictable transients in some of the controls. dV/dt notches on the common power line from one control will sometimes trigger SCRs on another control, therefore, separate isolation transformers are imperative in these applications.

2.0 Load Cell Checks

The load cell assembly mechanical connections and dynamometer assembly wiring and mechanical connections must be such as to minimize extraneous forces on the system.

- Load cell is mounted such that no lateral forces are applied. Only forces normal to the load cell mounting point are applied. At least one very free pivot point must be provided to minimize vibration induced and off-normal forces on load cell. Field and interlock wiring devices must be very flexible and formed in a loop at entry point.
- Cooling water and other connections at the dynamometer must be made with very flexible material. The material must be long enough, with an entry parallel to the dynamometer's axis and in a neutral position to minimize unmeasured and non-repeatable forces on the dynamometer's assembly.
- The load cell rating should be reasonable for the application. Undersizing may result in failure, but extreme oversizing will result in excessive zero/span drift. Temperature drift is related to full scale load cell rating, so using a load cell of two times the rating required will result in two times the drift.
- The dynamometer trunnion bearings must be properly lubricated and free or they will introduce a non-repeatable hysteresis into the static torque calibration. Check for paint, grit, etc. in areas between the dynamometer's free section and the dynamometer's static section.
- Check that torque/power decimal point placement is correct for your application. If the placement results in a maximum display of more than 4,000 units, the torque display will function properly, but the torque control loop may be unstable due to the high loop gain.

2.1 Checking Load Cell Mechanics

Use the following procedure to check load cell mechanics with no prime mover connected.

1. With the dynamometer in a zero torque condition, press down on the calibrating arm.
2. Slowly release the pressure.
3. Note the reading on the torque display including polarity.
4. Repeat the above steps pulling up on the calibrating arm.
5. Compare the two readings. A difference of zero indicates very good condition. If the difference is greater than two units, recheck the dynamometer for sources of hysteresis torque.

3.0 Setting the Current Limit

Use this procedure for eddy current dynos only.

If your dyno requires over 16 amps, use an external field power amplifier (model DS507 available from Dyne Systems Co., LLC).

The current limit adjustment is made on the DS256 PCB (left side panel), CFB potentiometer. This adjustment allows adapting to a wide range of dyno capabilities, provides protection of the field coil, and affects stability of the control system. You should also check that rear panel fuse sizing is such to protect for a continuous over-voltage condition in case of power unit failure.

1. Turn the CFB potentiometer fully CW (minimum field current).
2. Connect the meter to measure either field current or voltage.
3. Turn the FAULT BRAKE potentiometer (VR8 on DS501 PC board) fully CW.
4. Determine the actual field rating. If the field has been rewound, the rating may have changed.
5. With the dyno at a standstill and all power ON, press the DYNE ON PB button. If all interlocks are made, the control should latch DYNE ON. If the DYNE ON lamp drops out, check the H2O Interlock. If the underspeed trip has not been disabled, the Dyn-Loc should trip after about one second. This will cause the OS/US RESET PBPL to light and a high braking condition (current limit) on the field. If UNDERSPEED has been disabled, push EM STOP.
6. Turn CFB Pot CCW until you just achieve maximum desired field current/voltage or just reach the maximum available output from the Dyn-Loc (approximately 200 VDC with 240 VAC input). Do not set to exceed the field rating. Field voltage should be equal to the product of rated current and coil resistance at the time of the adjustment.
7. Push DYNE OFF PB and OS/US RESET PBPL simultaneously. Leave the meter connected for the next test.

4.0 Setting the Emergency Stop Level

Use this procedure with the meter still connected to the dyno coil.

1. Push DYNE ON PB then quickly push the EMERG STOP PB.
2. Confirm that the EM. STOP RESET PBPL extinguishes, and that full braking power is again applied to coil.
3. Adjust VR8 on DS501 PC board (labeled FAULT BRAKE) for the desired field current during fault condition.
4. Push EM. STOP RESET PBPL, then DYNE OFF PB and OS/US RESET PBPL simultaneously to reset the control.

5.0 Checking Magnetic Pickup

The Mag. PU/60 tooth gear system is critical to achieving the full system potential. The Electro 3030 or equivalent and 12 pitch gear is recommended.

1 Check for conformance to installation section wiring requirements. The sensed gear should be a 12 pitch beveled type, securely attached to the shaft. If the set screws are the primary retaining means, 3 #10 screws at 120º spacing are best. The shaft should have a flat for each screw and Loc-Tite should be used. Ensure any holes in the gear are not in a path to be measured by the pickup.

2 Check the gear on the dyno for less than .001" runout and damaged teeth. Either will affect control performance.

3 Ensure the Mag PU mounting should be stable, provide ease of air gap adjustments and a good flux path.

4 Clean out any iron chips in the air gap.

5 Set the air gap for 0.010".

6 Rotate the dyno rotor and check for variations.

7 If the bearings have excessive play, increase the air gap to avoid damaging the Mag PU.

8 Turn the dyno with the engine.

9 If an oscilloscope is available, check the Mag PU signal for good waveform and signal level per the control specs. A 10 percent modulation envelope indicates acceptable runout.

10 Check the displayed speed against another reliable source to confirm the proper sensing.

6.0 Stability Adjustments

Factory adjustments of the main control board(s), number of counts, gain, d SPD/DT, and SPEED LEAD usually provide good stability, response, and settling time. Performance checks will allow determination of any necessary changes. The CFB Pot is the only adjustment that affects torque mode stability. All adjustments affect the RPM mode. The DS503 CPU board's TQ_FILTER pot should be at 50 percent.

Factory settings for the control boards are listed in the table below.

Control Board	Setting
# COUNTS (DS502 SW2)	All ON
GAIN Pot. (DS502 VR1)	20% CW
dSPD/dT Pot. (DS501 VR4)	60% CW
SPEED LEAD Pot. (DS501 VR6)	50% CW

7.0 Performance Checks

1 Run the engine near peak torque speed at a wide open throttle (governor disabled). The engine itself must turn smoothly in order to perform the following tests.

2 Observe the RPM display, lock light, and sound of the engine.

- If the RPM display is steady at the set point, the lock light is steady on, and the engine sounds as if it were running smoothly, no adjustments are necessary.
- If the RPM display regularly deviates more than ±1 digit, the lock light flickers, and the engine sound indicates no missing but variable speed, slowly turn the dSPD/DT adjustment clockwise until the control stabilizes.

3 Repeat steps 1 and 2 at several setpoints to check overall performance.

4 Set LAC to 200.

5 Set the upper and lower digital setpoint switches for large changes in setpoint.

6 Perform several cycles of setpoint change and observe the RPM display for overshoot and settling time to new operating point.

- If the overshoot is 1 percent or less of the dyne/engine maximum speed rating and settling to ±2 RPM requires 2 cycles or less, no improvement is likely with adjustments. Continue this procedure. If a change has been made to #-of-COUNTS, restart this procedure.
- If the overshoot and/or settling exceeds these specs, turn SPEED LEAD Pot CW to 75 percent and recheck the transients. A SPEED LEAD setting above 50 percent may cause noise induced instability if there is more than 5 percent Mag PU modulation.
- If the SPEED LEAD adjustment does not achieve the desired results, throttle back to a no load condition. Go to the #-of-COUNTS dip switch and set #1 to OFF. This requires a brief check of worst case conditions in steps 1 through 5 where you may be able to reduce the dSPD/DT setting if desired. Continue this procedure. There should be a substantial decrease in overshoot and settling. Count #2 switch may be set to OFF also, if necessary. If the result is still undesirable, contact the factory.

7 Operate the engine in RPM modes as in step 1.

8 Perform the transfer to Torque mode, pre-loading the TQ display value into the not active leverwheel. Operate at several combinations of throttle and Torque setpoint. Set the Torque display DIP switch for minimum averaging.

- Dyne control should regulate to ±1 digit of setpoint for all combinations. The lock light should be On during all steady-state torque conditions if good dyno-engine mechanical conditions exist. Otherwise, the lock light may not show a steady indication. If the torque display shows ±1 digit maximum variation, the system is performing properly and no further action is needed.
- If the torque loop is not stable, turn the TQ_FILTER pot CCW slightly. If the condition worsens, turn it CW slightly past 50 percent of the factory setting.
- If the lock light flickers and display shows more than ±2 digits variation, check DS503B CPU Board TQ_FILTER Pot. adjustment. If necessary, turn the CFB Pot (DS256A PCB) very slowly CW until display stabilizes. If more than a 10 percent change was necessary in CFB Pot adjustment, recheck the mechanical system and torque decimal placement. If no changes in decimal placement or mechanical system

were found necessary, maintain the adjustment and restart the procedure for spot checks on performance.

– Reset the torque display averaging DIP switch to desired value.

8.0 Overspeed Trip Setting

1. On the Dyn-Loc rear panel, locate a two-section thumbwheel assembly labeled OVERSPEED TRIP.
2. Determine your maximum safe system RPM and set these switches for that value (divided by 100).

A trip will occur if the speed exceeds this setting for more than ½ second. Since this is a digital circuit, no adjustments are required. An overspeed trip will cause energization of the field at rated current, and change the state of the triac which is accessible on the rear panel barrier strip. The triac is rated at 50 ma, 120VAC max, and is meant to drive a pilot relay controlling such items as ignition, fuel, etc.

9.0 Other Control System DIP Switch, Jumper, and Adjustment Options

9.1 DS255 DIP Switch A

- Section 2 controls underspeed trip protection. If the DYNE is ON and no speed signal is received, a US Trip may occur causing dyno braking (adjustable), and change of state of the OS/US triac.
  - Section 2 OFF will enable this protection.
  - Section 2 ON will disable this protection.
  - Overspeed Trip will always be enabled.
- Sections 3 and 4 control the OS/US triac operation for a trip condition.
  - Section 3 ON and 4 OFF will provide an NC triac state.
  - Section 3 OFF and 4 ON will provide a NO triac state.
  - Section 3 ON and 4 ON is not recommended or useful.
  - Both sections OFF will defeat triac change of state.

9.2 DS105C Jumpers and DIP Switches

DIP switches A and B control the PIN F (only) encoder input and provide divide down of this input over a range of 1:1 to 512:1.

- 1:1 factor: SWB(3) only, closed.
- 2:1 factor: SWB(2 and 4) only, closed.
- 4:1 factor: SWB(1 and 4) only, and SWA all open.

- Using the remaining SWA settings you may obtain up to 512 division, in a binary sequence. SWB(4) must be closed for all divide down situations. Contac Dyne Systems' Service Department if you need assistance.

Jumpers

- JP1, JP2, Ra, and Rb provide means for single ended high level input to the load cell signal conditioner for use with a torque shaft signal conditioner.
  - Normal load cell applications require JP1 Out and JP2 In, with Ra and Rb Out.
  - For high level single ended inputs, connect Torque MS(C) to MS(D), and signal input to MS(B) with MS(D) as Common.
  - Ra and Rb are proportioned for dividing down the max signal input to approximately 50 mv max. JP1 is In and JP2 is Out for this application. Ra and Rb must be metal film low drift resistors. Rb must be approximately 350 ohms.
- JP3 controls the Analog Torque output polarity.
  - JP3(A-B) position provides positive output with positive display polarity.
  - JP3(A-C) provides reversed polarity of Analog output.

These DIP switches must be set to provide a 60 pulse per revolution square wave to the Dyn-Loc; therefore, the SWB(4) section must route the signal through a flip-flop. Contact Dyne Systems' Service Department if you need additional assistance.

10.0 DS105C Analog Torque and Speed Output Adjustments

These circuits are factory adjusted for 1 mv/RPM and 1 mv/Torque Unit.

10.1 Analog RPM

1. With a zero RPM display condition, adjust RPM Zero Pot for 0±1 mv output at TP1 with respect to TP2.
2. Input your application's maximum RPM using a signal generator into the RPM MS connector pin F with respect to PIN C (to +5V level square wave). Temporarily set the DS501 SW3 switch 3 on and switch 4 off, if necessary. You may get an Overspeed Trip if you exceed that setting; to avoid this, temporarily increase the OverSpeed setting.
3. Adjust RPM Cal Pot for the desired reading.
4. Repeat the above steps until no further change is required.
5. Remove MS(F) generator and return the Overspeed Trip thumbwheels to the proper setting.
6. Reset the DS501 SW3 to its previous setting.

10.2 Analog Torque

1. With a zero torque display condition, adjust the TQ Zero pot for 0±1 mv at TP3 with respect to TP4.

2. Apply the rated torque to the dyno.
3. Adjust the TQ SPAN pot for the desired Analog output. The AutoSpan function may be used to vary the torque value.
4. Repeat the above steps until no further change is required.
5. Adjust the TQ Filter pot for desired filtering of the Analog output.
6. If the span was changed, recalibrate the load cell display and remove the torque load from the dyno.

11.0 DS500 Series Control System Boards (Replacing DS250)

These newer Dyn-Loc IV controls have three new boards installed, replacing the DS250 board. These new boards have a number of new features.

11.1 DS500 Power Supply PCB

- The DS500 has a new, more robust switching power supply. It is designed to operate with a wider input range of 90-140 Volts AC input on L3 and L4 (if using 120VAC control power).
- The user still has a choice of 120/240VAC control power selected via an internal switch.

11.2 DS501/502 Reference Generator and Control PCBs

Many old style chips have been replaced with newer EPLD chips. This provides much higher component density and has allowed for many new improvements to be added.

- Significantly faster response during speed changes in RPM mode are now possible, without DV/DT interaction.
- More accurate TQ control at light TQ loads.
- Change from standard to one-tenth LAC via internal DIP switch for a wider selection of setpoint ramp rates.
- Instant loading of active lever wheel setpoint when the dyno is on.
- Adjustable fault braking on eddy current type dynamometers during an EM Stop, or OS/US faults.
- Motoring TQ mode is automatically selected either via external inputs or RS232 control. Available only on motoring type dynamometers.
- Enhanced serial communications by elimination of the hardware handshake requirement. A software handshake is still required in most cases.
- Magnetic pickup or Encoder signal input is now selected via internal DIP switches. This must be coordinated with the wiring.

11.3 Enabling a 1/10th LAC Mode

During normal operation the Dyn-Loc's LAC rate is adjustable from 39 to 5000 units per second. When the 1/10th LAC mode is enabled the LAC rates change to 3.9 to 500 units per second. To enable this, turn off the DIP SW1-4 located on the DS502 board.

11.4 Setting up Speed Signal Input Source

Select the type of speed feedback input source you are using. The following DIP switches are located on the DS501 board as indicated in the table below.

SW3-3	SW3-4	SW1-1	SW1-2	SW1-3	Setting
OFF	ON	OFF	OFF	OFF	Two wire magnetic pickup.
ON	OFF	OFF	OFF	OFF	Encoder pickup non-direction sensitive.
ON	OFF	ON	OFF	OFF	Encoder pickup with direction bit output.
ON	OFF	OFF	ON	OFF	Encoder pickup with direction derived from two change encoder signal.
ON	OFF	OFF	OFF	ON	Encoder pickup with direction derived from two channel encoder signal but inverts the direction.

11.5 Adjusting the Fault Braking on Non-Motoring Dynamometers

When the Dyn-Loc goes into an EM Stop or Over Speed/Under Speed trip, it will normally apply full current to the dynamometer coil. In some instances this is not desirable, so a 0 to 1 percent brake adjustment has been added. If an EMS or OS/US fault occurs, the Dyn-Loc will apply the brake preset current or control loop braking current, whichever is greater.

11.5.1 Method One

Use this method to set up without energizing the field winding.

1. Remove the top of the Dyn-Loc.
2. Install the negative (black) lead of a volt meter to TP11 on the DS501 board.
3. Attach the other lead (red) to TP8 to the DS501 board.
4. Confirm the Dyn-Loc is in RPM, MASTER mode and the dyno is not spinning.
5. Set in a setpoint of about 500 RPM or more on the active lever wheel switches. The voltage at TP8 goes to about 0 volts.
6. Press EM STOP on the Dyn-Loc. The voltage at TP8 increases.
7. Find the pot labeled FAULT BRAKE on the DS501 board. The usable range on the pot is from 0 (no fault braking) to 12 (maximum braking) volts.
8. Adjust the voltage for the desired percentage of the maximum level of braking torque.
9. Remove the volt meter.

10 Replace the Dyn-Loc lid.

11 Reset the Dyn-Loc out of its fault condition.

You must still set up the DS256A power amplifier CFB pot for desired maximum field current without exceeding the dyno name plate rating. This setting must be in excess of what is required to stall the engine under test.

11.5.2 Method Two

This method requires the dyno coil to be connected to the Dyn-Loc. The eddy current power amplifier should have its current limit adjustment (CFB pot) properly set.

1. Remove the top of the Dyn-Loc.
2. Install a DC volt meter across the field on the eddy current dyno. The two field fuses on the back of the Dyn-Loc can be temporarily removed so that you can safely install the meter.
3. Replace the fuses.
4. Confirm the Dyn-Loc is in RPM, MASTER mode, and the dyno is not spinning.
5. Set in a setpoint of about 500 RPM or more on the active lever wheel switches.
6. Press EM STOP on the Dyn-Loc. The voltage across the field jumps up and settles down at the voltage level.
7. Find the FAULT BRAKE pot on the DS501 board.
8. Adjust the pot to get the desired level of braking voltage across the coil you want during a fault.
9. Confirm this is adequate to stall the engine under test.
10. Remove the volt meter.
11. Replace the Dyn-Loc lid.
12. Reset the Dyn-Loc out of fault condition.

11.5.3 Method Three

This method requires the dyno coil to be connected to the Dyn-Loc. The eddy current power amplifier should have its current feedback properly adjusted. You must provide for sufficient torque during a fault stop to stall your largest engine.

1. Remove the top of the Dyn-Loc.
2. Turn the FAULT BRAKE pot on the DS501 board fully CCW.
3. Start the engine.
4. Set the desired speed setpoint.
5. Turn on the dyne.
6. Open the throttle until you get the desired torque load.
7. Press EM STOP. Nothing should happen at this point.
8. Begin slowly turning the FAULT BRAKE pot CW until you get the level braking you want. The speed decreases and the torque level increases until the engine stalls.

9 Replace the Dyn-Loc lid.

10 Reset the Dyn-Loc out of the fault condition.

11.6 Enhanced Torque Circuit

The enhanced torque circuit is now polarity sensitive. This sensitivity can be defeated by turning off DS502 SW2-Section#4. When connecting the load cell to the Dyn-Loc, the torque display must display a positive torque when the dyno is loading the engine. If this is not done, the torque feedback will be wrong polarity (regenerative), and the Dyn-Loc will stall the engine in torque mode.

11.7 Using Motoring Torque Mode

This is only available on motoring dynamometers.

11.7.1 Master Mode

When in master mode, you should be in torque mode with the dyne on and the engine running. You will notice when you dial in a torque value on the active lever wheel switches, it only loads the dyno producing a positive torque value. To go into motoring torque mode, apply +5 volts to pin 2 of the remote OCS connector found on the back of the Dyn-Loc. You can also jumper pins 2 and 30 together to get the same results.

11.7.2 Computer Mode

Refer to the section on RS232 port usage for method(s) of requesting a negative torque setpoint.

11.8 Instant Loading of a New Setpoint

You do not have to wait for the Dyn-Loc to LAC (ramp) to the new setpoint before you can turn the dyne on. The Dyn-Loc now loads the Active lever wheel switch value instantly when the Dyne On button is pressed.

11.9 Number of Counts DIP Switches

This is an RPM loop response adjustment. Set the DS502 SW2 switch positions 1 off or 1 and 2 both off to achieve a much faster speed integrator action. GAIN pot adjustment is no longer required. Switch 3 is not used and is set aside for future use.

11.10 Enhanced DV/DT Circuit

There are two choices in dSPD/dT (previously DV/DT) methods in RPM mode.

- Move Jumper 4 to Jumper 3 position on the DS501 to enable the old DV/DT mode.
- Move Jumper 3 to Jumper 4 position to enable the new dSPD/dT mode. This new dSPD/DT mode allows the dyno to make faster speed transitions without the dSPD/dT circuit hampering the dyno’s response.
- This would also affect dTQ/dT, which is rarely used.

11.11 DS501 Dip Switch Settings

The following tables display the encoder input configuration settings for the DS501 board.

Switch #	#1	#2	#3	Function
SW1	ON	OFF	OFF	Enables encoder direction input on pin D.
SW1	OFF	ON	OFF	Gets direction from channels 1 and 2 of encoder.
SW1	OFF	OFF	ON	Gets direction from channels 1 and 2 of encoder but inverts the direction.

Switch #	#4	Function
SW1	OFF	Normal operation with 60 tooth gear (PPR input)
SW1	ON	Doubles input frequency only when encoder channels 1 and 2 are both used. Should only be used with a 30 tooth gear.

The following table displays the speed signal source on the DS501 board.

Switch #	#1	#2	Function
SW3	ON	OFF	Enables encoder input.
SW3	OFF	ON	Enables mag-pickup input.
SW3	OFF	OFF	Not valid.
SW3	ON	ON	Not valid.

The following table displays the encoder direction circuit on the DS501 board.

Switch #	#1	Direction Bit
SW3	OFF	Disabled.
SW3	ON	Enabled.

The following table displays the DV/DT in torque mode on the DS501 board.

Switch #	#1	Torque Mode dTQ/dT
SW3	OFF	Disabled (factory default position).
SW3	ON	Enabled (not recommended).

The following table displays the dSPD/dT course ranging on the DS501 board. If these switches are changed, VR11 and VR10 may need re-adjustment. Consult Dyne Systems Co., LLC.

Switch #	#3	#4	Range
SW2	OFF	OFF	High.
SW2	OFF	ON	Medium.
SW2	ON	OFF	Medium.
SW2	ON	ON	Low (This position is for normal installations)

The following table displays the torque dTQ/dT signal source on the DS501 board.

Switch #	#1	#2	Function
SW2	ON	OFF	Frequency input on pin E of the load cell connector. JP1 has to be installed and JP2 has to be removed.
SW2	OFF	ON	Uses the Dyn-Loc's internal torque frequency.
SW2	OFF	OFF	Disabled.
SW2	ON	ON	Not valid.

11.12 DS501 Jumper Settings

The following table displays the enable input of the external torque DV/DT frequency input on pin E of the load cell connector (DS501).

JP1	JP2	Status
IN	OUT	Enabled.
OUT	IN	Disabled.

The following table displays the enable external IREF input into pin E of the load cell connector (DS501). With JP2 IN (external analog field control enabled), the Dyn-Loc RPM/TQ control loop is opened up and the dyno field is controlled directly from an external 0 to -12V analog reference.

JP1	JP2	Status
OUT	IN	Enabled external analog control of field.
IN	OUT	Disabled.

The following table displays the transitional DV/DT (usually dSPD/dT, rarely dTQ/dT) enable on the DS501.

JP3	JP4	Status
IN	OUT	Normal DV/DT enabled.
OUT	IN	Transitional DV/DT circuit enabled (recommended).
OUT	OUT	No DV/DT at all (not recommended).
IN	IN	Not valid.

The following table displays the Soft ON derivative during a mode change on the DS501.

JP5	Status
OUT	Enabled.
IN	Disabled (recommended).

The following table displays the enable Dyn-Loc remote stand push buttons on the DS501.

JP6	Status
Not used; for future expansion.	

The following table displays the enable Dyn-Loc remote stand push buttons on the DS501.

JP7	Status
OUT	Enabled only in REMOTE mode.
IN	Enabled in all modes (master, remote, and computer).

The following table displays the enable Dyn-Loc front panel push buttons on the DS501.

JP8	Status
OUT	Enabled only in MASTER mode.
IN	Enabled in all modes (master, remote, and computer).

11.13DS502 DIP Switch Settings

The following table displays the remote mode reference signal source on the DS502.

Switch #	#1	#2	Status
SW1	ON	OFF	Enables the external reference frequency input pin 25 Remote OCS connector (enabled for Dyn-Loc remote stand).
SW1	OFF	ON	Enables the external analog Ref. input pin F load cell connector.
SW1	OFF	OFF	No signal source selected.
SW1	ON	ON	Not valid.

The following table displays the LAC (Linear Acceleration) range on the DS502.

Switch #	#4	Function
SW1	OFF	1/10 LAC rate mode.
SW1	ON	Normal LAC rate mode (factory default).

The following table displays the enable external analog reference control while in computer mode on the DS502.

Switch #	#3	Function
SW1	ON	Enables the analog input while in computer mode.
SW1	OFF	Normal operation while in computer mode.

The following table displays the number of counts in up/down counter in RPM mode on the DS502.

Switch #	#1	#2	Function
SW2	OFF	OFF	Normal operation.
SW2	ON	OFF	Twice as fast response as normal.
SW2	ON	ON	Four times the normal response.
SW2	OFF	ON	Not valid.

The following table displays the TQ mode polarity sensitivity on the DS502. This can be checked by hanging a weight on the dyno in both positive and negative directions. If the lever wheels are set to match the torque in both cases, the lock should light if it is not polarity sensitive.

Switch #	#4	Result
SW2	OFF	Not polarity sensitive.
SW2	ON	Polarity sensitive.

The following table displays the reference generator divider circuit on the DS502. This is a normal setup for use with a 60-tooth gear. If you are using a speed pickup that does not output 60 pulses per revolution, contact Dyne Systems, LLC for the proper DIP switch configuration information.

Switch #	#1	#2	#3	#4	#5	#6	#7	#8
SW3	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF

11.14 DIP Switches and Jumpers on the DS503 CPU Board

The only DIP switch on the DS503 CPU board is an eight-section switch located in the left center of the board, designated SW1. Below is a table displaying DS503 CPU board DIP switch settings.

Switch #	Function
1	ON for TQ Data Acquisition using counter frequency channels instead of PAL based period measurement. The rate is 2hz. This affects the rate at which AZ/AS occur and eliminates availability of 10hz and 200hz torque data (default off).
2	ON for 10hz data displayed at 10hz. The averaged data is still available via the serial port, but the displays are updated using 10hz data.
3	ON for 200hz data displayed at 10hz. The averaged data is still available via the serial port, but displays are updated using 200hz data.
4	ON to double the effect of SW8 right of TQ display.
5	ON to display the message when e-squared write completed. This is useful in reminding the user. There are a finite number of times this device can be written.
6	ON to enable hardware CTS requirement for RS232 port.
7	ON if 80c187 is installed. If the switch is ON and no coprocessor is installed or it does not work properly, a HELP message is displayed.
8	ON for echo of characters received on main port. Turn this switch off for more efficient communications. Turn it ON to use the Dyn-Loc with a dumb terminal (default on).

11.15 DS503 Jumper Settings

11.15.1 Jumper setting descriptions

JP#	Function
1 - 4	Optional common connections for the analog and digital sections. They should always be out.
5	Used to reset the CPU. Short the jumper, then open it. The system should process as it does during power up. Some integrated circuits do not receive the system reset signal and may require power cycling to be reset. If a problem persists following reset, cycle the power.
6, 7	Determine the reference clock source for the PAL-based period mode frequency measurement system. JP6 should be OUT, and JP7 should be IN.
8, 9	Configure the clock source for the math coprocessor. JP should always be OUT, and JP9 should always be IN.
10	Does not exist on version B or later rev. PCBoard.
11, 12	Configure the clock mode for the math coprocessor. JP11 should always be IN, and JP12 should always be OUT.
13, 14	Used for setting the speed display decimal point. Refer to the table below.

11.15.2 Speed Display DP Options on the DS503

JP14	JP13	spd d.p.
OUT	OUT	00000
OUT	IN	0000.0
IN	OUT	000.00
IN	IN	00.000

11.15.3 Summary of DS503 CPU Board Jumper Settings

JP#	Description	Default Position	Comments
1	Optional Common tie points	OUT	Do not change
2	Optional Common tie points	OUT	Do not change
3	Optional Common tie points	OUT	Do not change
4	Optional Common tie points	OUT	Do not change
5	CPU RESET	OUT	Short momentarily to reset CPU
6	Ref. Clk Source	OUT	Do not change
7	Ref. Clk Source	IN	Do not change
8	’187 Clk Source	OUT	Do not change
9	’187 Clk Source	IN	Do not change
10	<non-existent>		
11	’187 Clk Source	IN	Do not change
12	’187 Clk Source	OUT	Do not change
13	Speed d.p.	OUT	See previous table
14	Speed d.p.	OUT	See previous table

11.16 LED Indicators on the DS503 CPU Board

11.16.1 LED1

LED1 should flash rapidly (10hz) to indicate the CPU and interrupts are functioning correctly. This will not start until the initialization and self-test(s) are completed.

11.16.2 LED2

LED2 is reserved for firmware debug tracing.

Chapter 6

Operating Instructions

Operation of the Dyn-Loc controller is identical for either a motoring type dyno (i.e., DC Four Quadrant) or a loading only type dyno (i.e., Eddy-Current) except for additional features available on the motoring type dyno. Both use the same master control unit, but their capabilities differ.

1.0 Eddy-Current Dynamometer Operation

1.1 Preliminary

1. Turn on the control and regulator power.
2. Allow 15 minutes warm-up for the load cell instrumentation circuits.
3. Check torque zero. Press auto zero if necessary while the engine is stopped.
4. If necessary, span and recheck the shunt cal (± values similar, magnitude shows to TQ circuit gain).
5. Check the following items.
   - Overspeed set point on the rear control panel. This safety will trip if the dyno RPM exceeds the setpoint by 1 - 2 RPM for 1 second causing a high braking torque on the engine (set previously for field current limit).
   - Ignition kill wire in place (if used). This is an important part of the redundant safety system backing up a control failure.
   - Coolant supply enabled up to the water solenoid.
   - Lubrication system level and air pressure for oil mist.
   - Power on if separate source is used for regulator.
   - Control Origin: Master or Remote as desired.
   - Engine coupling is OK.
   - Safety in place.
6. Check the existing LAC rate by setting the active leverwheel switches to zero and pressing the LAC Set PB located just above the switches. The RPM display will read the LAC in RPM/Sec. (or for Torque mode in TQ Units/Sec.).
7. Select either the upper or lower RPM/Torque digital switch assembly by actuating the adjacent red push button.

8 Enter the setpoint desired on the active (adjacent active lamp lit) digital switches. In Torque mode, the decimal point is automatically placed the same number of decimal places to the left as shown on the Torque display. The RPM uses no decimal point (excepting chassis dyno systems).

The engine must be rotating before DYNE ON is actuated or the underspeed (loss of feedback) safety will trip, causing imposition of high braking torque on the engine (and ignition disabled if used). This safety feature may be defeated by the appropriate Dip Switch settings on the DS255 PCB.

2.0 Eddy-Current Dynamometer Start-Up

2.1 Systems with Zero Speed Protection Enabled Start-Up

This technique results in zero engine/coupling shock.

1. Set the throttle for the desired warm-up speed range.
2. Actuate the RPM mode PB.
3. Set the active digital reference switches slightly above warm-up speed desired.
4. Start the engine.
5. As it is accelerating toward warm-up speed, actuate the DYNE ON PB. The control will exert a small torque on the engine as it accelerates, maintaining a maximum acceleration rate. If the engine does not reach the setpoint entered on the digital switches, there will be no steady state torque imposed by the control. If some loading is desired, increase the throttle setting or decrease the RPM setpoint.
6. Change further setpoints by changing the presently active switch setting or entering the new setting on inactive switches and actuating the adjacent active PB. In either case, note that changes take place gradually and you have sufficient time to correct a mistaken entry with either method used. This is a result of LAC action.

2.2 Systems with Zero Speed Protection Disabled Start-Up

1. Set the throttle.
2. Start the engine.
3. Trim the speed to allow warm-up.
4. Actuate the RPM mode PB.
5. Set the active digital reference switches slightly above warm-up speed desired.
6. Actuate DYNE ON PB. The control should not be imposing any torque on the engine.

7 Change further setpoints by changing the presently active switch setting or entering the new setting on inactive switches and actuating the adjacent active PB. In either case, note that changes take place gradually and you have sufficient time to correct a mistaken entry with either method used. This is a result of LAC action.

3.0 Setting the LAC (Rate of Change Setpoint)

The Linear Acceleration (LAC) value is expressed in units per second. For example, if the LAC value is currently 1000 units per second, and the control is in RPM mode, then it would take one second to get from a setting of 1800 RPM to a setting of 2800 RPM.

The LAC value refers to the amount of time it takes for the internal setpoint reference generator to reach its new value. The actual response time of the dynamometer may be slightly longer.

The actual LAC rate is generated by dividing a master frequency by an 8-bit divisor with the transfer function being Actual LAC (units per second) = 10,000/(N+2) where N is the 8-bit divisor. Due to internal hardware limitations, the value of N cannot be odd and must be greater than 1; therefore, only certain integer values are obtainable for the actual LAC rate. The computer inside the Dyn-Loc IV calculates the nearest possible value of N in accordance with the requested LAC rate (set on the active switches on the front panel) and calculates the nearest possible units per second obtainable. This number is then displayed momentarily on the RPM readout, flanked by dashes.

- The LAC value may be entered either from the front panel or from the host computer via the serial or parallel port.
- The LAC value entered via the serial port is separate from that entered via the front panel and is only effective when the control is in COMPUTER mode.
- The LAC value entered via the front panel is only effective when in MASTER mode.
- The two different values are retained by the controller when power is lost or when switching between COMPUTER and MASTER modes.
- To enter the LAC value for MASTER mode operation, complete the following.

  1 Turn off the dynamometer.

  2 Set the currently active leverwheel switches to the desired LAC rate in units per second.

  3 Press the recessed push button marked LAC SET using a pencil or other soft pointed instrument. The RPM displays the actual rate the controller was able to obtain, flanked by dashes. If the upper (5000) or lower (39) is exceeded, a help message is displayed.

- To query the existing LAC setting, set the active leverwheel switches to all zeros and push the LAC set push button. The existing LAC setting is displayed in the RPM display flanked by dashes.
- The LAC of remote unit is set via DIP switches in the remote enclosure.
- Fast LAC rates are uncommon. For example, 5000 and the next lower value is 2500.
- Slow LAC rates are common and spaced close together. For example, 39 and the next higher value is 40.
- To bypass the LAC in RPM, press TQ then RPM. Do the opposite if you are in TQ mode.

4.0 Entering Setpoints

Enter the setpoints after completing the following.

- The start-up procedure is complete.
- The control is in DYNO ON in RPM or TQ mode.
- The dynamometer is stable.

Change the setpoint in one of two ways.

- Change the setting on the currently active lever wheels and the setpoint will ramp at the existing LAC setting.
- Set the desired new setpoint on the inactive lever wheels, then press the active button to change to that set of lever wheels. The setpoint will ramp at the existing LAC setting. The control must be in master mode for the lever wheels to control the setpoint.

There are two disadvantages to the first method.

- Changing from 1999 to 2000 is clumsy.
- Working the leverwheel mechanism when it is active causes wearout failure over time, and it is expensive to repair.

5.0 Mode Changes and Transients

Zero transient mode changes with controller active (DYNE ON) are accomplished automatically by the internal hardware and firmware of the Dyn-Loc. To initiate a bumpless mode transfer, copy the inactive mode display data into the inactive leverwheel, and press the push button for the new mode.

6.0 Forced Engine Stop Using the Dynamometer

Forced engine stop using the dynamometer is accomplished in either RPM or Torque mode.

6.1 RPM Mode

In RPM mode with the Dyne On, set the active digital switches to any setting other than 0 below the possible engine operating speed. The dyno will gradually force the engine down to a stall. As the engine stalls, activate DYNE OFF PB to avoid an underspeed trip condition. If an underspeed trip does occur, actuate DYNE OFF PB and OS/US RESET PB simultaneously.

6.2 Torque Mode

In Torque mode with the Dyne On, increase the active digital switch setting beyond the engine's capability, causing an engine stall. As the engine stalls, actuate the DYNE OFF PB to avoid an underspeed trip condition.

7.0 Emergency Stop

Emergency Stop is accomplished by actuating the large red EMERG STOP PB. This results in the extinguishing of the green EM.STOP RESET PBPL and high braking by the dyne. Reset by first actuating the EM. STOP RESET PBPL then actuate DYNE OFF PB and OS/US RESET PB simultaneously.

8.0 Transferring to Computer Control Mode

Computer Control Mode is enabled by actuation of the COMPUTER PB. While in this mode, the setpoint and LAC settings are available only through the serial port unless the serial port is bypassed internally.

- When the COMP PB is pressed and the computer control mode is entered, the latest COMP mode LAC and SETPOINT are activated.
- The EMSTOP button is still available to the operator while in COMP mode, but the remaining functions are disabled unless MASTER is pressed.

9.0 Motoring Dynamometer Operation

Relay IGN in the power amplifier unit may be used for ignition control by connection across the ignition points circuit. The option jumper is found on DS102 PCB in the power amplifier cabinet. If the IGN relay is properly connected, the DS102 PCB jumper in AB position inhibits ignition when in DYNE OFF condition. DS102 PCB Jumper in AC position allows ignition when in DYNE OFF condition.

Select the direction of the engine rotation by sliding the switch on the PCB DS102 in the 4 quadrant PAU cabinet. This sets the motoring and loading directions of the dyne. Motoring torque will be in the direction chosen and loading torque will be in the opposite direction.

Motoring dynamometer operation is identical to eddy current operation with the following exceptions.

- The engine may be started by the dynamometer using the automatic motoring capability.
  1. Select the desire warm-up speed on the digital switches.
  2. Actuate the DYNE ON PB. The dyno will accelerate the engine to the selected setpoint at a rate based on the LAC setting.
- The dyno may be started in torque mode, but this is not recommended.

- When in RPM control, the dynamometer will automatically switch from motoring to loading of engine in order to hold the setpoint. This is transparent to the observer except for the change in torque polarity as this occurs.
- Switching to Torque mode is identical to the eddy-current technique except you will see a short period of torque display offset from setpoint immediately following the switching. A similar momentary offset may be observed after switching from Torque to RPM mode.
- Emergency Stop is by passive dynamic braking (dyno energy is dissipated in a DB resistor). Since this must not be allowed indefinitely, the Emergency Stop condition times out in 10 seconds. It then turns the dyno field power off. Emergency Stop from a high speed may cause an OV shut down. If so, ask a technician to check for maximum armature voltage under these conditions and correct the OV condition.

10.0 Remote Operator’s Station

Remote units are typically used in the test cell when frequent operator presence at the test engine is required.

The Remote Operator’s Station’s functions are identical except for absence of Auto Zero, Auto Span, Shunt Cal, front panel LAC setting, and OS module. EMERG STOP PB is active on both Master and Remote stations at all times, however, the EM STOP PRESET PBs are active only for the enabled unit.

10.1 Using the Remote Unit

The Master Unit leverwheel switches must be maintained at a setting greater than 40 or the control circuit is locked out, preventing the remote control of setpoints.

The LAC settings for the remote unit are changed using the DIP switch located on the main PCB.

When switching control from the Master to Remote or Remote to Master, complete the following steps.

1. Set the same reference as the value of the controlled variable on the Active leverwheel switches of the incoming unit. The reference to LAC to the new value will be displayed in a few seconds.
2. Actuate the appropriate PBPL to transfer control to the incoming unit. The transfer should cause no transient since no change was made in reference signal to the controller. Setpoint and mode changes are made identically as in the Master Unit, and all instrumentation is echoed in the Remote unit.

Chapter 7

Computer Interfacing

1.0 Serial Port Hardware Format

The Dyn-Loc IV uses standard RS232 voltage level definitions (MAXIM MAX-233 interface IC).

Switch #4 under the POWER display bezel must remain off or the system setup will be completely reset to defaults when the unit is reset via the power cycling or any other means.

1.1 Data Format (Baud)

The data format (baud),N,8,1 has the following characteristics. If you want the changes in the baud rate setting to take effect, the Dyn-Loc must be control power cycled.

- Selectable via the DIP switch under the POWER display bezel.
- No parity.
- Eight data bits.
- 1 STOP bit.

Table 1.1: Baud Rates (DIP switch under POWER display bezel)

Switch #3	Switch #2	Switch #1	Baud Rate
OFF	OFF	OFF	256000
OFF	OFF	ON	128000
OFF	ON	OFF	115200
OFF	ON	ON	57600
ON	OFF	OFF	38400
ON	OFF	ON	19200
ON	ON	OFF	9600
ON	ON	ON	4800

1.2 Clear to Send (CTS) Input to the Dyn-Loc

The CTS input to the Dyn-Loc is configured via the DS503 CPU Board DIP switch #6.

- If switch #6 is on, the CTS is required and should be set by the host to an RS232 logic 1 if the Dyn-Loc can transmit to the host. If this line is held at a logic one level, characters will be transmitted continuously unless the Dyn-Loc's print buffer is empty. When the CTS is

enabled by switch #6, the following is a hardware feature of the CPU chip’s integral serial I/O port. The characters will not be sent from the Dyn-Loc unless the CTS is true. This line may be pulsed for transmission of a single character.
- If switch #6 is off, the Dyn-Loc will transmit to the host regardless of the state of the CTS.

1.3 Request to Send (RTS) Output

The RTS output from the Dyn-Loc to the host computer is always true. The Dyn-Loc is always ready to receive characters; however, most host programmers will want to use the software handshaking feature described in the next section.

1.4 RS232 Signals

The Dyn-Loc does not use any of the remaining RS232 signals (DTR, DSR, etc.).

2.0 Serial Port Software Format

The Dyn-Loc recognizes the following two command formats. Both formats require the host computer to perform some type of "software handshake."

- ASCII commands use characters read via a terminal screen. They are the most commonly used for low and medium applications. In ASCII mode, the Dyn-Loc presents its prompt character (\) when it is finished processing the latest command.
- BINARY commands are faster and require fewer bytes of data to represent a number or command. In BINARY mode, the Dyn-Loc uses ACK (value of 6) for indicating the command was understood, and the response is forthcoming.

The Dyn-Loc does not use any software handshake such as XON/XOFF; however, it does offer its own software handshake method.

3.0 Serial Port ASCII Commands

3.1 Why Choose ASCII

There two reasons the host computer programmer might choose to use the ASCII command set.

- Although the binary command set will suffice for most datacq and control applications, it does not provide for configuration or calibration. This is the main reason to possibly mix the two types of commands in your application (binary is more efficient).
- The ASCII command set is understandable when using a dumb terminal, making experimentation much easier for learning purposes, and the program is more readable.

3.2 Keywords Command Line

Keywords are a sequence of ASCII characters containing no spaces. The Dyn-Loc contains a look-up table which makes up the list of keywords it understands. The command line is a maximum of 80 ASCII characters. It is composed of keywords and numbers or other arguments always separated by spaces and terminated by pressing Enter.

With few exceptions, the command line can contain as many valid keyword/argument sequences as will fit in its max length of 80 characters. These individual commands are processed in sequence when Enter is pressed.

Commands which return data to the host will do so by appending a carriage return by default. If the host application requests data be returned without pressing Enter, the final keyword in the command should be followed by a semicolon without spaces. For multiple commands on a single command line, each command which requests return data must have its own semicolon.

3.3 Control Codes

In addition to pressing Enter, the Dyn-Loc understands many other control codes. The majority of these are in the Binary Commands section of this chapter. The remainder, associated with the use of the ASCII command set, are summarized below.

Keyboard Command	Value	Action
Ctrl+A	1	Enables "actual rate achieved" LAC message.
Ctrl+B	2	Disables "actual rate achieved" LAC message.
Ctrl+C	3	Clears the command line and resends the prompt; clears rx/tx ring buffers.
Ctrl+H (backspace)	8	Rubs out one character.
Ctrl+M (Enter)	13	Initiates the processing of the command line.
ESC	27	Clears the command line and resends the prompt; clears rx/tx ring buffers.

3.4 The Prompt (\) Character

It is strongly recommended that the host application use this software handshaking feature. This feature ensures the host does not send another command until the current command line is finished executing. Although the Dyn-Loc will successfully buffer large amounts of incoming data and process them as Enter is pressed, operations such as mode and setpoint changes have not actually been completed until the prompt is returned.

Most programming languages' communications libraries have a check flag feature which allows the programmer to set up an automatic flag that is set when a specific character is received, and can be reset by the programmer through a special function call. Contact Dyne Systems if you need further assistance.

By using this strategy, the application is not tied up waiting for the prompt unless it sends multiple commands in sequence, yet it ensures the Dyn-Loc has finished the latest command before another is sent. To read the data returned to the host by the Dyn-Loc, create another function call that waits for the prompt and reads the rx buffer.

3.5 Hardware Handshaking Option

The Dyn-Loc RS232 firmware does not perform hardware flow control using any of the dedicated lines (CTS, RTS, DTR, DSR, etc.); however, the DS503 CPU board DIP switch #6 may be set to ON to enable the built in CTS hardware feature of the 80C186EB CPU's integral serial I/O port.

The host may use this to its advantage if there are times when the user does not want the system to use time to honor serial rx interrupts. By setting CTS temporarily false, the data will be saved in the Dyn-Loc send buffer and sent to the host when CTS is again held true. The host may request the Dyn-Loc send a single character by pulsing the CTS line true for at least 1 micro-second. This will only cause a character to be transmitted if one is already pending in the send buffer.

For most host applications, switch #6 can be set to OFF, reducing the conductor count to two wires and a shield.

3.6 Standard Notation for Command Reference

Commands will be shown preceded by a backslash character (PROMPT, \). This is what is actually happening and is what will be displayed if the user is learning by typing commands in a dumb terminal.

- If a command requires no data or arguments, then nothing will follow in the formal definition.
- If a command requires argument(s) and they are not optional, they will be displayed as <argument>.
- If a command requires argument(s) and they are optional, they will be displayed as {argument}.

Arguments can be either data or additional keywords. Data arguments can be one of the following notations. Commands are shown in standard notation followed by a description of any alternate uses.

Arg Notation	Definition
int16	16 bit unsigned integer.
Sint16	16 bit signed integer.
float	32 bit single precision floating point.
string	null terminated string.

3.7 Repeat Command

Commands are preceded by a backslash character (PROMPT, \). This is what is actually happening and is what will be seen if the user is learning by typing commands at a dumb terminal. Do not actually type in the backslash character.

To speed up multiple uses of the same command without intervening uses of another command, Dyne Systems has provided the Repeat command.

- **\R** repeats the latest successful command.
- **\R?** returns the latest repeatable command.

Not all commands are "remembered" for use with R. This is so seldom used commands do not erase the repeat memory. Below is a table displaying commands that are and are not remembered for repeat.

Repeat Command Table

Command	Repeatable?
H0	Yes
H1	Yes
I0	Yes
I1	Yes
M0	Yes
M1	Yes
SP	Yes
LAC	Yes
MD	Yes
DR	Yes
SR	Yes
THR>	Yes
THR<	Yes
IN	Yes
OUT	Yes

Repeat Command Table

Command	Repeatable?
AZ	No
AS	No
SC	No
LW	Yes
RLCW	No
RLCO	No
RLCOI	No
RLA	No
RLB	No
RLC	No
RLM	No
RLMD	No
RLDV	No
RLDVA	No
RLSIN	No
RLDM	No
RLDA	No
RLG	No
RLF	No
RLSS	No
RLSL	No
RLSLI	No
RLSTART	No
RLSTOP	No
RLRESET	No
VERSION?	No
DTCVER	No
CLS	Yes
TALK	No
E2P	Yes
AZ?	No
AS?	No
FREE	No
’	No
RCC	Yes
DCC	No

3.8 Querying the Firmware Version

Commands are shown preceded by a backslash character (PROMPT, \) as this is what is actually happening and is what will be seen if the user is learning by typing commands at a dumb terminal. Do not actually type in the backslash character.

\VERSION? or **\VER** causes the Dyne-Loc to transmit a string depicting the current firmware revision residing in your control.

This string has the following format.

Dyn-LocIV <> DS503+carriage return+line feed+vx.xx mm-dd-yy+carriage return+linefeed

3.9 Configuration Commands

Commands are shown preceded by a backslash character (PROMPT, \) as this is what is actually happening and is what will be seen if the user is learning by typing commands at a dumb terminal. Do not actually type in the backslash character.

Most of the Dyn-Loc's standard configuration items are set via DIP switches and jumper blocks. If RoadLoad is being used, an extensive amount of setup information is set via RS232 commands and stored in the EEPROM.

3.9.1 Setting a Non-Standard Display Units Code

This topic mainly relates to RoadLoad operation, as it is normally only used for chassis dynos; however, there may be instances when it is used for other reasons.

\UC <int16> This command sets a non-standard display units code. The default is 0, which causes the Dyn-Loc to follow the settings on the DIP switch under the TQ display bezel (switches 6 and 7). Non-0 codes will be assigned per customer requirements and supplemental documentation provided.

3.9.2 Setting Error Que Mode

This command sets the way in which system error messages are buffered prior to transmission to the host computer. This setting affects the three methods of binary data acquisition. When writing drivers for these, be aware of the anticipated setting for the error que.

\EQ 1 This command is the default state following a RESTART. This mode is different from previous versions of the Dyn-Loc in that asychronous errors such as EMSTOP and OSUS are held in a buffer to be transmitted during the next host transaction. It also causes binary datacq responses to start with a code 7 instead of a code 6 (ACK), notifying the host of an error residing in the que. The remainder of the binary response consists of the error number followed by null bytes for remaining bytes expected.

\CQ This command clears any pending errors from the que. It is only meaningful while EQ 1 is in effect.

\EQ 0 This command tells the Dyn-Loc to handle error messages as with earlier versions (transmitted immediately).

3.9.3 System Restart

When the commands **\RESTART** or **\SYS RESTART** (for compatibility with older systems) is issued, the system is completely reset to factory defaults. These values include the following.

- RoadLoad system reset to its defaults.
- Auto-Span and Auto-Zero settings to defaults.
- LAC "actual rate achieved" message is turned off.
- LAC rates (COMPUTER and MASTER modes) set to max.
- Special display units code cancelled (set to 0).
- Crash counter is reset to 0.

These defaults are written to the EEPROM, and the system reboots.

3.9.4 Forcing E-Squared Write

This applies only to RoadLoad systems.

\E2P This command causes the system to update the EEPROM from values currently in RAM. This is done automatically for all normal system setup items (AZ, AS, etc.), but in RoadLoad is only done at certain times. This command was provided to allow users of the RoadLoad system the flexibility of storing setup at other than the pre-determined events.

3.9.5 Resetting the Crash Counter

One word of the EEPROM is set aside for counting the number of times the system has self-recovered from a noise induced CPU failure. This counter gives an indication of the installation environment. This counter is reset to 0 upon RESTART and when the command is executed.

\RCC This counter is independent of the remainder of the data stored in the EEPROM and is not a part of the checksum.

3.10 Data Acquisition Commands

Commands are preceded by a backslash character (PROMPT, \). This is what is actually happening and is what will be seen if the user is learning by typing commands at a dumb terminal. Do not actually type in the backslash character.

3.10.1 Acquiring 200hz Data

If the host computer and operating system are fast enough to process three characters of tx and two to six characters of rx data every 5 ms., then ASCII high speed datacq can be used. If this does not work, try the BINARY method. The Hx (High Speed) data commands are as follows.

\H0 will return the latest 5 ms. speed rating.

\H1 will return the latest 5 ms. torque rating.

3.10.2 Acquiring 10hz Data

The 5 ms. data accessible via Hx commands is averaged over 20 cycles to create the 10hz data. This data is available via the Mx (Medium Speed) commands.

\M0 is for speed data and **\M1** is for torque data.

3.10.3 Acquiring 50hz Data

The high speed (200hz) data is also used to create another level of averaging at 20 ms. The apparent confusion in terms is due to this level being created for the RoadLoad system after the other two were in use. The Ix Commands (Intermediate Speed) are as follows.

\I0 for speed data and **\I1** for torque data.

3.10.4 Acquiring Averaged (Displayed) Data

The format for this command is a holdover from previous versions of the Dyn-Loc. To acquire the value that is actually being shown on the LED readout, use this command. The format for this command is **\DR <datatype>** where <datatype> can be one of the following.

- RPM returns speed data.
- TQ returns torque data.
- PWR returns power data.
- POS returns DTC-1 position data, if attached (error otherwise).

3.10.5 Acquiring All Averaged Data in a Single Block

The command **\AD** returns all three displayed variables plus the status in a single string, saving communication time. It is recommended that binary datacq be used in place of the AD command, but it has been provided for compatibility with older systems.

The format of the string returned by the AD command is **Status Word + CR + Power + CR + Speed + CR + Torque** (where CR is a carriage return (hex 0D)).

The power and torque strings will contain sign and decimal point according to dp settings on DIP switches. This command will appear as a jumble on a dumb terminal unless CR is translated to CR/LF by the terminal itself.

3.10.6 Acquiring Dyn-Loc Status Bits

To acquire a 16 bit word representing the status of the Dyn-Loc, type **\SR**.

The data returned must be interpreted bit by bit according to the following Dyn-Loc Status Word Bit Assignments table.

Status Bits

Bit	Logic 1
0	Torque sign is negative
1	Unused
2	Unused
3	Unused
4	DS503 is connected to DS502
5	Motoring dyno
6	DTC-1 attached and powered up
7	Unused
8	DYNE ON

Status Bits

Bit	Logic 1
9	LAC ready (ramp complete)
10	COMP
11	ABSorb only
12	OS/US trip
13	LOCKed
14	RPM
15	EMStop

3.10.7 Reading the Lever Wheel switches

In some instances the host program may need to use the Dyn-Loc's digital switches as a remote means of indicating a procedural branch or simply as a remote data input source. The command **\LW** returns the current setting of the currently active set of switches.

The Dyn-Loc must be in MASTER mode or an error message will result.

3.11 Control Commands

Commands are shown preceded by a backslash character (PROMPT, \) as this is what is actually happening and is what will be seen if the user is learning by typing commands at a dumb terminal. Do not actually type in the backslash character.

3.11.1 Selecting Operating Modes

There can only be one MoDe command per command line. Other commands may be mixed on the same command line.

MoDe Commands must be in the form **\MD <mdspec,mdspec,...mdspec>** where mdspec are mode request specifier keywords and must be selected from the following table.

mdspec	Request Mode
MSTR	MASTER
REM	REMOTE
COMP	COMPUTER
RPM	RPM
TQ	TORQUE
DON	DYNE ON
DOFF	DYNE OFF
ABS	ABSORB ONLY
EMS	EMERGENCY STOP

For example, to attempt a change to COMPUTER and TORQUE modes with DYNE ON, type **\MD COMP,TQ,DON**. When RPM or TQ are specified, the Dyn-Loc automatically enters the currently displayed value of Speed or Torque as the setpoint, for a 'bumpless' transfer.

3.11.2 Setting the LAC

Unlike the BINARY LAC set command (which specifies a divisor), the ASCII version requests a certain units per second setting. The Dyn-Loc will get as close as possible to the requested rate, but because of hardware limitations cannot always obtain the exact rate requested. Depending on the state of the LAC 'actual rate achieved' message enable/disable setting, there may or may not be a message string returned indicating what rate was obtained.

\LAC <int16> requests a LAC rate in units per second ignoring the decimal point. The number must be between 39 and 5000.

\LAC RAPID will set bit 0 of the divisor causing infinite rate of change.

3.11.3 Changing the Operating Setpoint

When RPM or TQ are specified with an MD command, the Dyn-Loc automatically enters the currently displayed value of Speed or Torque as the setpoint, for a 'bumpless' transfer.

For RPM mode, use **\SP <int16>**.

For TQ mode, use **SP <Sint16>** (optional sign).

The Dyn-Loc will ramp to the new setpoint at the existing LAC rate.

3.12 Calibration Commands

Commands are shown preceded by a backslash character (PROMPT, \) as this is what is actually happening and is what will be seen if the user is learning by typing commands at a dumb terminal. Do not actually type in the backslash character.

The Torque display can be calibrated from the serial port in the exactly the same way as from the front panel. Functionally the calibration is identical, but the leverwheel switches are not used for the span value; the number is a part of the command line. Ignoring this difference, these serial port functions can be considered simulations of pressing the push buttons on the front panel - they invoke the exact same firmware sections and will produce the same help messages if there is a problem.

3.12.1 Zeroing the Torque Display

AZ will invoke the same procedure as pressing the AUTO ZERO push button.

3.12.2 Spanning the Torque Display

This command has two forms corresponding to spanning using weights and spanning using the shunt cal circuit. The command **\AS <int16>** simulates a span using the AUTO SPAN push button and weights. <int16> is the desired span value, which would be set on the leverwheel switches if front panel cal was being performed.

AS SC <int16> simulates using the AUTO SPAN and SHUNT CAL push buttons simultaneously.

3.12.3 Activating SHUNT CAL

The difference between this command and the SHUNT CAL push button is that the unbalance cannot be 'held' indefinitely like it can by holding the push button indefinitely. When the command **\SC** is issued, the load cell will be unbalanced for approximately four seconds. If the display averaging is set too high, the host may need to use the M or I unaveraged data request commands to acquire the shunt cal reading.

Example: *\SC<ENTER>\M1<ENTER>*

3.13 DTC-1 Commands

The Dyn-Loc communicates with the DTC-1 via its dedicated serial port (25 pin D connector dedicated to the DTC-1). The baud rate is fixed at 19200, so set the DTC-1 for 19200,N,8,1. Consult the DTC-1 programming manual for information not supplied here.

Commands are shown preceded by a backslash character (PROMPT, \) as this is what is actually happening and is what will be seen if the user is learning by typing commands at a dumb terminal. Do not actually type in the backslash character.

The Dyn-Loc 4/186 will only work with DTC-1 revision 4.x or later. Older DTC-1 versions do not have the proper serial port hardware configuration.

3.13.1 Automatically Formatted DTC-1 Commands

The MD, LAC, and SP commands can be used automatically by prefixing them with THR.

For more information on DTC-1 MoDes, LAC range and SetPoint ranges, consult the DTC-1 manual.

3.13.2 Sending any DTC-1 Command, No Wait for Answer

To send an arbitrary literal string to the DTC-1, use the command **THR> <string>**.

The Dyn-Loc does not check the syntax of <string> and does not wait for any data return from the DTC-1.

3.13.3 Sending any DTC-1 Command, Wait for Answer

To send an arbitrary literal string to the DTC-1, use the command **THR< <string>**.

The Dyn-Loc does not check the syntax of <string>, but does wait for data return from the DTC-1. The data return (if any) will be sent from the Dyn-Loc to the host.

\THR< VERSION? is equivalent to the 'canned' command for retrieving the DTC-1 firmware version.

3.13.4 Querying the DTC-1 Firmware Version

To find out what the DTC-1 firmware revision is, use the command **\DTCVER**. This is equivalent to **\THR< VERSION?**.

3.13.5 DTC-1 'Type Through' Mode

The Dyn-Loc can be placed into a mode where it is acting as a link between the host and the DTC-1. In this mode, the Dyn-Loc is not checking syntax of its own command set. It is passing every character it receives on the DTC-1, and all characters coming from the DTC-1 are sent to the host. To enter this mode use the command **\TALK** or **\THR TALK**.

In this mode, the backslash will be preceded by an asterisk to indicate to the host the Dyn-Loc is passing through the DTC-1. This mode is mainly for test and debug use. It is a good indication of the functionality of the link between the Dyn-Loc and the DTC-1.

To exit this mode send the ESC (value of 27) character.

3.14 RoadLoad Commands

This group of commands is designed for configuring and controlling operation of the EPA RoadLoad function. This function uses the '186/'187 CPU pair as a firmware-controlled closed loop implementation of the EPA-mandated formula.

This function is designed specifically for chassis dynos and is used to simulate a sequence of driving conditions, usually for satisfying emissions requirements.

$$\mathbf{F = A + B*v + C*v^2 + (M-Md)Dv + M*g*sinH}$$

- Where F is calculated every 20 ms. and used as the TQ mode setpoint.
- A, B, C, M, Md, and sinH are pre-settable constants (although they actually reside in RAM).
- v is the vehicle velocity (the Speed channel).
- Dv is the derivative of velocity.
- All 'constants' (A,B,C,sinH, etc.) can be changed at any time during the test.
- Units are Kg, Meters, Seconds, KPH and Newtons.

3.14.1 Setting ROM Defaults

Values other than v (the Speed channel) and its derivative (which are dynamic) are resident in RAM during system operation and are remembered in the EEPROM through power cycling. To reset these values to ROM-defined defaults, use the command **\RLRESET**. The actual ROM default values are subject to change.

3.14.2 Control Word

A 16 bit control word is used to determine the state of various RoadLoad system options. The bit assignments (flags) are described in the following table.

bit	Logic 1
0	Running (ON, RLSTART in effect)
1	Keep A constant in cutoff calculation
2	Display current F calculation as power
3	Use averaged derivative
4 - 13	Reserved
14 - 15	Internal use only

Only those bits shown in boldface are available for user modification. The others will be masked from the data given by the user with the command **\RLCW {int16(hex)}**. This will modify the control word as desired. The Dyn-Loc requires this to be in hexadecimal format. This format was chosen for its readability in bit set/reset control.

\RLCW ? or **\RLCW** returns the current value of the ControlWord.

3.14.3 'CutOff' Velocity (KPH)

Below a certain velocity, the data is not timely enough for use of the velocity and velocity derivative related terms of the equation. This velocity break is settable via the command **RLCO {float}** or **RLCOI {int16}**.

The {float} and {int} versions of this command operate on the same memory location. Using either command changes the same variable. CutOff Velocity can be altered at any time regardless of START/STOP or other ControlWord status.

3.14.4 Setting 'Constants'

The following commands can set or return the value specified by the letters following RL in the keyword. These numbers can be altered at any time, regardless of START/STOP or other ControlWord status.

\RLA {float}

\RLB {float}

\RLC {float}

\RLM {float}

\RLMD {float}

\RLSIN {float}

3.14.5 Querying and Resetting the Derivative

This command is usually used for debug purposes as a means of seeing what the derivative is doing. It could, however, be used to reset the derivative to 0 at a critical point. **\RLDV {float}** will reset or return the current value of the derivative. **\RLDVA {float}** will reset or return the current value of the averaged derivative.

The instantaneous and averaged derivative are stored separately in RAM and can be queried independently of one another regardless of the state of the ControlWord derivative type selection.

3.14.6 Derivative Averaging Period

If the ControlWord is set for using the averaged derivative in the formula, set the averaging period for the derivative. **\RLDA {int16}** sets or returns the current number of 20 ms. periods over which a 'moving window' average is performed on the derivative.

The instantaneous and averaged derivative are stored separately in RAM and can be queried independently of one another regardless of the state of the ControlWord derivative type selection.

3.14.7 Derivative Multiplier

This multiplier is used specifically to correct for the measurement period of 20 ms. It is used in conjunction with the (M-Md) factor. **RLDM*(M-Md)*Dv** is the actual calculation.

The derivative multiplier would usually be left at its default value of 50.000, but it can be queried/modified using the command **\RLDM {float}**.

3.14.8 Gravitational Constant

The constant 'g', the acceleration of gravity at the surface of the earth, cannot be altered. For debug purposes (to check that the ROM defined value is correct), the command is **\RLG**. This returns the current ROM definition of g in Meters/sec^2 (9.8076 is correct).

3.14.9 Force Calculation

For debug purposes, the latest calculation of force can be queried with the command **\RLF**.

3.14.10 Setpoint Limit

To allow for limiting the maximum value of force to be used as a setpoint use the command **\RLSL {float}** to set or return a floating point version based on the current force (Torque) display d.p. setting. Use **\RLSLI {int}** to set or return an integer (ignoring d.p.) version of the setpoint limit.

The {float} and {int} versions of this command operate on the same memory location. Using either command changes the same value.

3.14.11 Starting and Stopping RoadLoad

The RoadLoad system is not always making calculations or outputting setpoints to the control boards. For the calculations and setpoints to be active, the command **\RLSTART** must be in effect. This command operates on bit 0 of the ControlWord. RLSTART sets bit 0 indicating that calculations and setpoints are wanted. The RLCW command does not allow modification of bit 0 because there are other conditional checks and startup operations that are performed by RLSTART. RLCW can be used to query the START/STOP status of RoadLoad.

To STOP (disable) RoadLoad calculations and setpoints, issue the command **\RLSTOP**. This resets bit 0 of the ControlWord, halting calculations and outputting of force setpoints to the controller circuitry. It is up to the user to define the ending sequence using the MD and SP commands. RLSTOP cannot be implemented using RLCW.

3.14.12 CoastDown Option

The firmware provides an option for automatic 'CoastDown' verification. When all settings such as 'A', B', 'C', 'M', etc. are correct, use this option to check the time it takes the chassis dyno to ramp between an upper and lower speed setting.

To set and query the upper and lower speeds for CoastDown, use **\US {float} LS {float}**.

To reset the CoastDown system (the upper and lower speeds) to ROM defaults of 70.00 and 50.00, use **\CDRESET**. CDRESET emulates CDSTOP, and resets the timer to 0.

After the upper and lower speeds are set, use the MD and SP commands to put the dyno into speed mode at a setpoint above the US setting. When the speed is stable (Dyn Loc LOCKed), issue **\CDSTART** to initiate the CoastDown sequence. The status of the CoastDown sequence can be

queried at any time using the command **\CDSTATUS**. This command returns an integer, the value of which indicates the state the CoastDown system is in the following sequence.

0=idle,1=wait for upper speed,2=wait for lower speed, 3=complete

After issuing the CDSTART command, query using CDSTATUS until a value of 3 is returned. The timer is reset to 0 and started at the upper speed and automatically stopped at the lower speed. To get the time period, use **\CDTIME**.

The time period between upper and lower speeds is returned in floating point, to two decimal places. This reading is accurate to +/- 20 ms.

3.14.13 RoadLoad Command Summary

Command	Description
RLRESET	Running (ON, RLSTART in effect)
RLCW {int16} (hex)	ControlWord: Configure options via bit set/reset
RLCO {float}	Query or Set CutOff velocity via floating point
RLCOI {int16}	Query or Set CutOff velocity via integer
RLA {float}	Query or Set A value
RLB {float}	Query or Set B value
RLC {float}	Query or Set C value
RLM {float}	Query or Set Mass value
RLMD {float}	Query or Set downstream Mass (roll mass)
RLSIN {float}	Query or Set sinH (sin of angle of hill)
RLDV {float}	Query or Reset derivative
RLDVA {float}	Query or Reset averaged derivative
RLDA {float}	Query or Set derivative averaging period
RLDM {float}	Query or Set derivative multiplier (should be 50)
RLG	Query gravitational constant
RLF	Query latest force calculation
RLSL {float}	Query or Set setpoint limit via floating point
RLSLI {int16}	Query or Set setpoint limit via integer
RLSTART	Start RoadLoad
RLSTOP	Stop RoadLoad
CDSTART	Start CoastDown sequence
CDSTOP	Stop (interrupt) CoastDown sequence
CDRESET	Reset CoastDown system to ROM defaults
CDTIME	Returns CoastDown timer in seconds x.xx
CDSTATUS	Returns CoastDown system status
US {float}	Sets or queries CoastDown UpperSpeed
LS {float}	Sets or Queries CoastDown LowerSpeed
Binary 23	CoastDown data group*
Binary 24	RoadLoad data group*

* Special binary commands. Contact Dyne Systems Co. LLC for details.

3.15 Troubleshooting Commands

Commands in this group are intended for use in debug/troubleshooting, mainly at the factory or possibly in conjunction with phone consultation. With the exception of the OUT command, these can do no harm.

3.15.1 Comments (', single quote)

This is a means of testing serial port operation. It allows for a maximum length command line without regard for syntax. This can be used at high baud rates to test for proper protocol. Assign a long readable comment to a function key in your dumb terminal program, watch that no characters are lost, and watch that there are no overrun or framing errors detected at either end. This could also provide for comments in a 'batch' command file being typed out the serial port from the DOS command line (unusual).

A comment can appear anywhere, on the command line. All characters following the single quote (') are considered comments, and are not processed by the command interpreter.

3.15.2 Querying d2a Settings

While troubleshooting the Torque instrumentation circuitry, the user may want to know what number the firmware is setting into the digital to analog converters. Zero and Span each have their own setting and can be queried with commands **\AZ?** and **\AS?**.

3.15.3 Port I/O

To know what data is present at an input port address or to modify the data outputted to a port during troubleshooting, use the following commands.

\IN <int16(hex)> returns the data present at input port address specified in hexadecimal.

\OUT **<int16(hex)>,<int16(hex)>** outputs to port,data in hexadecimal format.

Do not use the OUT command indiscriminately. It does not do any checks on or limit the address provided on the command line. Use of the wrong address could alter the CPU or peripheral setup in which could cause partially correct system operation. To put a pre-check on the address defeats the purpose of this command, which is to allow for manipulation of the peripheral setup during troubleshooting without the need for firmware re-write.

3.15.4 Free Memory

This command can be used to compare free memory with what is expected by the factory technician. FREE memory does not change with system operation. It is determined by the firmware (ROM) usage. **\FREE** returns the number of bytes of the 64k static RAM currently unused.

3.15.5 Simulating Power Cycling

\REBOOT causes the control to vector to the same bootstrap as is used for power up or by shorting the RESET jumper (JP5) on the DS503 CPU Board. This is not identical to a system reset via power cycling or JP5 as the hardware reset line is not asserted, and some devices use this for internal initialization. This command is intended mainly for checking the power up sequence. If there is a real problem, use power cycling or JP5 hardware RESET. Reboot will change the baud rate per section 1.1.

3.15.6 System CRASH Detection

The DS503 CPU Board has a hardware feature called a watchdog timer designed to detect whether or not the CPU is running properly. If the CPU does not reset this circuit via its firmware within a certain time period, an NMI is generated. The firmware itself provides other forms of failure detection such as trapping unused interrupt vectors. A command is provided to simulate a CPU 'meltdown' and check that the watchdog circuit is functioning properly:

\CRASH purposely scrambles the memory and disables all interrupts, causing the NMI to occur. An error message and HELP display should be seen and the system should recover, and the setup (AZ, AS, etc.) should be properly restored from the EEPROM.

Whenever a crash is detected, a special location in the EEPROM is incriminated. This location can be examined to see how many crashes have occurred:

\DCC will 'dump' the crash counter out the serial port.

\RCC will reset the crash counter to 0.

3.16 Dyn-Loc RS232 Command Summary Table

The RoadLoad functions are not included in this summary.

Command	Arguments	Description
’	<string>	Comment (ignored by system)
AD	none	Return all displayed data in ASCII, CR separated
AS	<int16>	Simulate AUTO SPAN push button
AS?	none	Acquire existing auto span d2a setting
AZ	none	Simulate AUTO ZERO push button
CLS	none	Clear dumb terminal screen
CRASH	none	Simulate CPU crash occurrence
CQ	none	Clear error que (no effect if EQ 0)
DCC	none	Query: how many crash recoveries?
DR	<data type>	Acquire averaged data
DTCVER	none	Force update of setup to EEPROM
EQ	<int16> (0 or 1)	Setup error que mode, 1=use que, 0=no que
FREE	none	Query: how must RAM is unused?
H0	none	Acquire 200hz speed
H1	none	Acquire 200hz torque
I0	none	Acquire 50hz speed, V4.1 and up only
I1	none	Acquire 50hz torque, V4.1 and up only
IN	<int16(hex)>	Input from port address
LAC	<int16>	LAC change
LW	none	Acquire leverwheel switches
M0	none	Acquire 10hz speed
M1	none	Acquire 10hz torque
MD	<mdspec,mdspec,...mdspec>	MODE change
OUT	<int16(hex)>, <int16(hex)>	Output to port address
R	none	Repeat latest command
R?	none	Query: what was the latest command?

Command	Arguments	Description
RCC	none	Reset system crash recovery counter
REBOOT	none	Simulate power cycling or JP5 RESET
RESTART	none	Revert to ROM defaults for entire system
SC	none	Simulate SHUNT CAL push button
SP	<int16> or <Sint16>	Setpoint change
SR	none	Acquire status word
TALK	none	Type through mode to DTC-1
THR	none	Prefix for canned DTC-1 commands
THR<	<string>	Send literal to DTC-1, WAIT for response
THR>	<string>	Send literal to DTC-1, NO wait for response
VER	none	Acquire firmware (ROM) version info
VERSION?	none	Acquire firmware (ROM) version info

3.17 Error Message Format

An error message string will be sent from the Dyn-Loc to the host application or dumb terminal in response to any of the following conditions.

- An ASCII or BINARY RS232 command was in error or tried to perform an operation that failed.
- There was a framing or overrun error on the RS232 interface(s).
- An EMSTOP or OS/US occurred.
- A calibration operation failed.
- A MATH EXCEPTION occurred.
- A CPU crash was detected and recovery was successful.

The host application can count on the same format for all error messages received from the Dyn-Loc. It will always be a string of the form

BELL+cr/lf+"Error"+SPACE+ErrorNumber+" - "+Error Description String+cr/lf

where BELL is a value of 7 (ASCII code for terminal bell) and is the primary indicator of the start of an error message. The host application can use this fact to scan for error returns after every command.

There are two instances in which additional string data will be returned.

- If the error originated from the DTC-1, the error string is exactly as received from DTC-1+cr/lf.
- If the error was due to CPU crash recovery, "Trap Code = "+trap code number+cr/lf (where the Trap Code is equal to the HELP number indicating what type of event caused the crash).

3.18 Dyn-Loc 4/186 RS232 System Error Messages by Number

Error #	Dyn-Loc Message	Description
4	Bad Lookup Index	Non-Critical firmware error. A keyword was added to the lookup table, but no procedure was entered into the call table. Contact factory.
6	Incomplete Sequence	Data or additional keywords required by the command were not supplied on the command line.
7	Keyword too long	Too many characters in a keyword (string of characters on command line without intervening spaces).
8	Syntax	A keyword was not found in the lookup table. If you believe you are not in error, contact the factory.
9	DL4 Inactive	Bit indicating presence of control board not seen. Either there is a connection problem between the DS503 CPU board and the DS502 control board, or there is a problem with a trace on either board.
10	DTC-1 Inactive	Two attempts at software handshake with the DTC-1 have failed. Either the cable is bad, the DTC-1 is not powered up, the DTC-1 has a hardware problem, or the DTC-1 is not configured correctly.
11	Numeric Syntax	A numeric argument was required and there were characters in that KeyWord which did not make sense as part of a number.
13	Numeric String too long	Too many characters for the DynLoc's numeric string conversion buffer. This should never happen because the buffer is far larger than a sensible numeric string.
21	DTC Error	A code 7 (BELL) was detected in the data return from the DTC-1. All data following the BELL character will be sent to you following this error message. Refer to the DTC-1 manual.
23	Illegal ’i’ Code	Non-critical firmware error. The interpreter assigned an execution code during compilation that was not entered into the executor's call table. Contact the factory.
40	Divide by 0	Non-Critical firmware error. An integer divide was attempted with a divisor of 0 or the quotient was too large to fit in the destination operand. Contact the factory.
42	MODE Conflict	A MoDe command was attempted with conflicting mode types (for example RPM and TQ in same command)Non-Critical firmware error.
43	MODE Verify	The hardware was unable to accomplish the requested mode change. This could be due to operator intervention (holding down a button) or hardware failure.
50	Illegal P.B. Function	An illegal combination of front panel push buttons was pressed. All combinations of two buttons are legal. This reduces to a hardware failure or more than one or two buttons being pressed at once.

Error #	Dyn-Loc Message	Description
55	AS/AZ Timeout	The calibration operation could not be completed within time limits. This could be instability in the load cell, circuitry, or a hardware failure.
60	Rx Framing (main port)	The rx machine in the 186 detected a bad character. This is not associated with a parity check, but it probably means a bad number of start or stop bits at the host end or mismatched baud rates.
61	Rx OverRun (main port)	The 186 was too busy to honor two successive incoming characters. It may indicate a hardware failure.
74	Emergency Stop	The system went into Emergency Stop mode via Dyn-Loc or DTC-1 front panel switch or via EMS mode command.
75	Overspeed/ Underspeed	Overspeed or Underspeed trip.
77	Rx Framing/OverRun (DTC port)	There is a baud or format problem between the Dyn-Loc and DTC-1, or the DTC-1 is not v4.x or later hardware/firmware. It could also be a cable problem.
78	Must be in MSTR Mode to read LeverWheels	The LW command will work only if the Dyn-Loc is in MASTER mode due to hardware design holdover from previous versions.
79	’Last’ Command is Undefined	The R command was attempted before a repeatable command was entered successfully.
80	Main Rx Buffer OverFlow	The host application is not using the software handshake and has blasted too many characters at once on the Dyn-Loc.
81	DTC Rx Buffer OverFlow	The DTC-1 software handshake is not working due to improper baud or other format and too many unrecognizable characters have been received from it.
82	DTC Tx Buffer OverFlow	Non-critical firmware error. The DynLoc's tx ring buffer dedicated to the DTC-1 was written too many times without actually initiating a send. Contact the factory.
84	’Crash’ Recovery	Indicates an NMI (watchdog timer) or other crash detection scheme has caused the '186 to self recover. A message will follow indicating what type of trap was detected. Contact the factory for advice on solving these problems.
85	More than one MoDe change in command line	Due to foreground/background processing organization, the firmware does not allow more than one MD command per command line. Break your mode changes into separate commands.
86	SetPoint command attempted with RoadLoad ON	The RoadLoad system completely takes over the outputting of setpoints to the control boards. Do not attempt to enter setpoints using the SP command if RoadLoad is running.
87	Mode Change command attempted with RoadLoad ON	RoadLoad by definition uses TQ mode. Do not attempt mode changes while RoadLoad is running.

Error #	Dyn-Loc Message	Description
88	RoadLoad function attempted without 80C187	RoadLoad is heavily dependent on high speed floating point math and MUST have the '187 to run.
89	RoadLoad function attempted while using counted TQ	RoadLoad depends on high speed datacq and must be using the PAL based Torque Data Acquisition system. Be sure switch # 1 is OFF and an EPLD is installed for the Torque channel.
90	Dropped out of COMP TQ DON mode while in RoadLoad	If for any reason the Dyn-Loc drops out of the required mode for proper RoadLoad operation while RoadLoad is ON this error results and RoadLoad halts.
91	RoadLoad Soft Start TimeOut	After RLSTART command is issued the system tries to ramp slowly to near enough to the first calculations of force to avoid a jolt to the rider or driver of the vehicle under test. This error indicates a timeout trying to do so (if this operation succeeds the system reverts to very fast ramps to all subsequent force calculations).
92	d.p. config changed while RoadLoad ON	The RoadLoad system must make various conversions based on the d.p. configurations for the Speed and Torque displays. It is not safe to change these while running.
93	CoProcessor Exception: Invalid Operation	Refer to Chapter 9, Section 3.2.
94	CoProcessor Exception: Denormalized Operand	Refer to Chapter 9, Section 3.2.
95	CoProcessor Exception: Divide by 0	Refer to Chapter 9, Section 3.2.
96	CoProcessor Exception: Overflow	Refer to Chapter 9, Section 3.2.
97	CoProcessor Exception: Underflow	Refer to Chapter 9, Section 3.2.
98	CoProcessor Exception: Precision Loss	Refer to Chapter 9, Section 3.2.
99	CoProcessor Exception: UNKNOWN	Refer to Chapter 9, Section 3.2.
100	Calibration Attempted while in RoadLoad	A front panel push button operation was attempted while the RoadLoad was ON. RoadLoad is a control loop and only works with DYNE ON. Do not attempt to calibrate during RoadLoad.
101	Cannot start RoadLoad while in a PushButton Function	Similar to 100, but a cal function was in progress while RLSTART command attempted.

Error #	Dyn-Loc Message	Description
102	RoadLoad is already ON	RLSTART performs functions for entering a soft start sequence. Do not issue the RLSTART command if RoadLoad is already ON.
103	RoadLoad is NOT ON	Cannot RLSTOP if not in RLSTART.
104	Cannot change Display Setup while in RoadLoad	You changed a DIP SWITCH setting affecting d.p. placement while RoadLoad was ON (running).
105	Must have '187 for special display units code	Special display conversions require the math coprocessor for floating point operations.
106	Must have special display units code for RoadLoad	The RoadLoad system depends on non-standard speed encoder and display relationships. See the UC command.
107	Must have '187 for CoastDown operations	The US, LS and CoastDown timer functions require the math coprocessor for floating point operations.
108	CoastDown Upper speed must be > Lower speed	The 'lower' speed setting is greater than the 'upper' speed setting for CoastDown.
109	CoastDown start speed must be > Upper speed	CoastDown sequence cannot start until dyno is running above the 'upper' speed setting (US command).
110	CoastDown TIMEOUT	Dyno stayed between upper and lower CoastDown speed settings for more than 60 seconds.

3.19 New Dyn-Loc 4/186 Operating System Features

Customer feedback has contributed to the changes in the DynLoc RS232 Op-Sys firmware operation.

- Increasing complexity in customer needs has caused the discontinuation of the DLBasic operating system. This system was intended for simple step-type test programs embedded directly into the DynLoc's memory. We have found that trying to accommodate the real needs of our customer test systems is not practical using this compiler. We will continue to support existing users but the DS503 '186 CPU system will not support DLBasic.
- The Dyn-Loc operates more efficiently over the RS232 port. This has to do not only with changes in the quality of the hardware but with how data is acquired (how frequency is measured). Much of the datacq task has been relegated to PAL systems, leaving the CPU free to communicate. This ties in with the new 10, 50, and 200hz data rates available.
- There is no usage of most of the SYS... configuration commands such as error response formatting and character echo control. We have made this more reliable by reducing the configuration to a single DIP switch setting controlling echo of characters received.

4.0 Serial Port BINARY Commands

4.1 Why use BINARY?

- The BINARY command set is more efficient because there are fewer characters required for a given transaction. For higher throughput, these commands can be used in conjunction with a fast baud rate.
- The BINARY command set is limited in scope; therefore, most users will need to mix ASCII and binary commands in their host software.

4.2 The BINARY Handshake

All binary transactions take the following form.

- The host computer sends the Dyn-Loc a single byte code indicating which transaction is desired.
- The Dyn-Loc returns an ACK byte (value of 6) indicating the start of the return data block (if any).
- The Dyn-Loc returns a constant number of bytes specific to each type of transaction.

The host programmer should scan the receive buffer for the ACK byte then wait for exactly the number of bytes expected from the transaction (Control Commands return ONLY an ACK byte).

4.3 BINARY Data Acquisition Commands

If the error que mode is ON (EQ 1), the data return block for Data Acquisition commands (only) will be special if an error is waiting in the que.

4.3.1 Return data block for EQ 1 setup if error waiting in que.

Byte	Description	Value
0	BELL	7
1	error code	Error number
2	DTC error code	Error code
3-N	NULL	0

4.3.2 D.P. Placement Byte

The 'd.p. placement byte' returned by Datacq commands contains information for the format of all three variables. The tables shown here for interpreting the d.p. placement byte apply to all datacq commands.

D.P. placement controlled by 'DIP switches' under right hand display bezel (DL4) or by SETUP mode 4,0,0 (DTC). SPD d.p. is controlled by DS503B JP13/JP14.

Torque D.P. Format (D.P. Placement Byte)

Bit1	Bit0	Format
0	0	±00000
0	1	±0000.0
1	0	±000.00
1	1	±00.000

Power D.P. Format (D.P. Placement Byte)

Bit3	Bit4	Format
0	0	±00000
0	1	±0000.0
1	0	±000.00
1	1	±00.000

Speed D.P. Format (D.P. Placement Byte)

Bit5	Bit4	Format
0	0	±00000
0	1	±0000.0
1	0	±000.00
1	1	±00.000

4.3.3 Data Dump WITHOUT DTC-1 Status Word

There are three nearly identical codes for this transaction. They differ in the level of averaging used for the data returned.

- code 5 = Averaged Data (Display data)
- code 6 = 10hz Data
- code 7 = 200hz Data

There are exactly 12 bytes of data returned in response to codes 5, 6, and 7.

Byte	Description	Value
0	ACK	06
1	Status low byte	Status Word
2	Status high byte	
3	Position low byte	Current DTC-1 Position
4	Position high byte	
5	Speed low byte	Current Speed reading
6	Speed high byte	
7	d.p. placement byte	See tables in Section 4.3.2
8	Torque low byte	Current Torque reading
9	Torque high byte	
10	Power low byte	Current Power reading
11	Power high byte	

4.3.4 Short Form Data Dump with DTC-1 Status Word

There are three nearly identical codes for this transaction. They differ in the level of averaging used for the data returned.

- Code 9 = Averaged Data (Display data)
- Code 10 = 10hz Data=0A
- Code 11 = 200hz Data=0B

There are exactly 14 bytes of data returned in response to codes 9, 10, and 11.

Byte	Description	Value
0	ACK	06
1	Status low byte	Status Word
2	Status high byte	
3	Position low byte	Current DTC-1 Position
4	Position high byte	
5	Speed low byte	Current Speed reading
6	Speed high byte	
7	d.p. placement byte	See tables in Section 4.3.2
8	Torque low byte	Current Torque reading
9	Torque high byte	
10	Power low byte	Current Power reading
11	Power high byte	
12	DTC Status low byte	DTC Status Word
13	DTC Status high byte	

4.3.5 Short Form Data Dump (Spd/Tq Only)

There are three nearly identical codes for this transaction. They differ in the level of averaging used for the data returned.

- Code 16 = Dec = 10 hex Averaged Data (Display data)
- Code 17 = 10hz Data = 11 hex
- Code 18 = 200hz Data = 12 hex

There are exactly 6 bytes returned in response to codes 16, 17, and 18.

Byte	Description	Value
0	ACK	06
1	Speed low byte	Current Speed reading
2	Speed high byte	
3	d.p. placement byte	See tables in Section 4.3.2

Byte	Description	Value
4	Torque low byte	Current Torque reading
5	Torque high byte	

4.3.6 Get RoadLoad DEBUG Information

Code 24 **Dec = = 18 hex** returns a large amount of information concerning the present state of the RoadLoad system. ‘Float’ means single precision 32 bit floating point number. ‘Int' means 8 or 16 bit integer.

Byte	Description	Value
0	ACK	06
1-2	Flags	Existing ControlWord
3-6	A	Float
7-10	B	Float
11-14	C	Float
15-18	M	Float
19-22	Md	Float
23-26	sinH	Float
27-30	Dv	Float
31-34	Dv multiplier	Float
35-38	g	Float
39-42	Cutoff velocity	Float
43-46	Setpoint limit	Float
47-50	F calculation	Float
51-60	F string conversion	StringZ
61-64	v	Float of speed
65-68	f	Float of torque
69-72	Ave. derivative	Float
73-74	Cutoff vel. integer	Int
75-76	Setpoint Limit integer	Int
77	Num cycles deriv. averaging	Int
78	d.p. placement	See tables above

4.3.7 PAL-Based Frequency Measurement DEBUG Dump

Most users will never need to access this code. It is used by the factory test and debug software and is included here for completeness and internal use. Contact the factory if you believe you need to use this information.

Code 26 **Dec = = 1A hex** returns a large amount of information regarding the state of the EPLDs used by the Data Acquisition system for measuring frequency of Speed and Torque channels.

Byte	Description
0	ACK (6)
1	Speed samples ([extent])
2	Speed cycles [0]
3	Speed counts bits 0-7 [0]
4	Speed counts bits 8-15 [0]
5	Speed counts bits 16-31 [0]
6	Speed cycles [1]
7	Speed counts bits 0-7 [1]
8	Speed counts bits 8-15 [1]
9	Speed counts bits 16-31 [1]
10	Speed cycles [2]
11	Speed counts bits 0-7 [2]
12	Speed counts bits 8-15 [2]
13	Speed counts bits 16-31 [2]
14	Speed cycles [3]
15	Speed counts bits 0-7 [3]
16	Speed counts bits 8-15 [3]
17	Speed counts bits 16-31 [3]
18	Speed cycles [4]
19	Speed counts bits 0-7 [4]
20	Speed counts bits 8-15 [4]
21	Speed counts bits 16-31 [4]
22	Speed cycles [5]
23	Speed counts bits 0-7 [5]
24	Speed counts bits 8-15 [5]
25	Speed counts bits 16-31 [5]
26	Torque samples ([extent])
27	Torque cycles [0]
28	Torque counts bits 0-7 [0]
29	Torque counts bits 8-15 [0]
30	Torque counts bits 16-31 [0]
31	Torque cycles [1]
32	Torque counts bits 0-7 [1]
33	Torque counts bits 8-15 [1]
34	Torque counts bits 16-31 [1]

Byte	Description
35	Torque cycles [2]
36	Torque counts bits 0-7 [2]
37	Torque counts bits 8-15 [2]
38	Torque counts bits 16-31 [2]
39	Torque cycles [3]
40	Torque counts bits 0-7 [3]
41	Torque counts bits 8-15 [3]
42	Torque counts bits 16-31 [3]
43	Torque cycles [4]
44	Torque counts bits 0-7 [4]
45	Torque counts bits 8-15 [4]
46	Torque counts bits 16-31 [4]
47	Torque cycles [5]
48	Torque counts bits 0-7 [5]
49	Torque counts bits 8-15 [5]
50	Torque counts bits 16-31 [5]
51	Torque sign [0]
52	Torque sign [1]
53	Torque sign [2]
54	Torque sign [3]
55	Torque sign [4]
56	Torque sign [5]
57	RefClock bits 0-7
58	RefClock bits 8-15
59	RefClock bits 16-23
60	RefClock bits 24-31

4.4 BINARY Control Commands

Control Commands have the potential to fail due to hardware problems or invalid bit sets (in the case of MODE commands).

- If the operation succeeds an ACK byte is returned.
- If the operation fails, a standard ASCII error message string is returned.

There is no other data return associated with Control Commands.

4.4.1 Dyn-Loc MODE control

Code 25 starts the Dyn-Loc Mode Control command. There are three bytes total that must be sent to the Dyn-Loc.

Byte	Description
0	start sequence (25) Dec = = 19 hex
1	mode bits low byte
2	mode bits high byte (see next table)

Bytes 1 and 2 of the Dyn-Loc Mode Command are organized as follows. ALL 'unused' BITS MUST BE LOGIC 0.

Bit	Description
0	DYNE ON
1	MASTER
2	COMPUTER
3	ABSORB ONLY
4	DYNE OFF
5	TORQUE
6	RPM
7	EMSTOP
8	REMOTE
9	unused
10	unused
11	unused
12	unused
13	unused
14	unused
15	unused

4.4.2 DTC-1 MODE Control

Code 4 starts the DTC-1 Mode Control command. There are three bytes total that must be sent to the Dyn-Loc.

Byte	Description
0	start sequence (4)
1	mode bits low byte
2	mode bits high byte (see next table)

Bytes 1 and 2 of the DTC-1 Mode Command are organized as follows. ALL 'unused' BITS MUST BE LOGIC 0.

Bit	Description
0	unused
1	unused
2	unused
3	unused
4	unused
5	TORQUE
6	RPM
7	EMSTOP
8	unused
9	unused
10	MANUAL
11	AUTO
12	ON
13	OFF
14	POS
15	VAC

4.4.3 Dyn-Loc LAC Control

Code 28 starts the Dyn-Loc LAC Control command. There are two bytes total that must be sent to the Dyn-Loc.

Byte	Description
0	start sequence (28) 28 Dec = 1C hex
1	LAC divisor byte (see next table)

The LAC divisor is in binary and represents N in the formula.

LAC(units per second) = 10000/(N+2)

4.4.4 Dyn-Loc SETPOINT Control

Code 29 starts the Dyn-Loc SETPOINT Control command. There are three bytes total that must be sent to the Dyn-Loc. The SETPOINT is in signed binary.

Byte	Description
0	start sequence (29) Dec = 1D hex
1	SETPOINT low byte
2	SETPOINT high byte

4.4.5 DTC-1 LAC Control

Code 30 starts the DTC-1 LAC Control command. There are three bytes total that must be sent to the Dyn-Loc. The DTC-1 LAC is a number (units/sec.) NOT a divisor.

Byte	Description
0	start sequence (30) Dec = 1E hex
1	LAC low byte
2	LAC high byte

4.4.6 DTC-1 SETPOINT Control

Code 31 starts the DTC-1 SETPOINT Control command. There are three bytes total that must be sent to the Dyn-Loc. The SETPOINT is in signed binary.

Byte	Description
0	start sequence (31) Dec = 1F hex
1	SETPOINT low byte
2	SETPOINT high byte

4.5 BINARY Command Summary Table

Below is a summary of currently available BINARY Dyn-Loc Command codes.

Decimal Code	Hex Code	Description	Total Bytes	Comments
25	19	Dyn-Loc MODE control	3	bit sets
4	4	DTC MODE control	3	bit sets
28	1C	Dyn-Loc LAC control	2	divisor
29	1D	Dyn-Loc SETPOINT control	3	signed binary
30	1E	DTC LAC control	3	direct units/sec.
31	1F	DTC SETPOINT control	3	signed binary
5	5	total data dump	12	AVE, no DTC status
6	6	total data dump	12	10hz, no DTC status
7	7	total data dump	12	200hz, no DTC status
9	9	total data dump	14	AVE, includes DTC status
10	A	total data dump	14	10hz, includes DTC status
11	B	total data dump	14	200hz, includes DTC status
16	10	spd/tq dump	6	AVE
17	11	spd/tq dump	6	10hz
18	12	spd/tq dump	6	200hz
24	18	Get RoadLoad information	80	for debug
26	1A	Get PAL information	61	for debug

5.0 Parallel Computer Control

5.1 Bypassing the Serial Port for SP/MD/LAC

If the parallel SETPOINT, MODE, and LAC control are desired, the internal DS503B CPU Board can be disconnected from the DS500 series control board's computer control port and the rear panel "parallel control" connector plugged in instead. This leaves the internal CPU intact for performing instrumentation tasks. The serial port will still operate, but the mode, setpoint, and LAC control commands will return the 'DLC inactive' error message if attempted. All other serial port commands (including Data Acquisition) remain operable.

Parallel control capability has existed in the Dyn-Loc for many years. Before serial ports became common, parallel control was a serious option. Currently, parallel control is not a good option, requiring significant hardware and still some software. It is seldom used, but documented below.

5.2 Parallel Control Port Characteristics

- Control data transfer is via C-MOS circuitry, so caution should be exercised during connection/disconnection to avoid exposure of the circuits to high voltages or static discharge. Always disconnect power from the Dyn-Loc when working on the I/O cabling.
- Status and Data Output source and sink capability is 15 mA maximum. If the LED optical couplers are used in conjunction with these outputs, observe these current restrictions (transistor driver may be required).
- Parallel Control is 5 Volt C-MOS logic with 10K input pull down resistors. A true-input must be +3.7V minimum and +5V maximum. A false input level must be +1V maximum and 0V minimum. All control inputs to the Dyn-Loc posses an internal 25 microsecond filter necessary to eliminate pulse noise effects which are unavoidable in the engine test environment. It is necessary to hold all input levels for at least 50 microseconds to ensure accurate data transfer.
- If relay contacts are used for parallel inputs, these should be of bifurcated design with a wiping action to insure low ohmic connections. Contact bounce effects can be eliminated by holding a level at least twice the period of bounce duration.

5.3 Parallel Control Port: Setting the LAC

The rate of change of the setpoint (LAC) is controlled over a wide range by computer entry of an eight bit, parallel, binary word. This data is entered as the least significant 8 bits of the 16 bit set-point bus (this bus has 10K pull down resistors but no filtering). The controller interprets this entry as LAC data by the use of the Latch Enable 2 latch bit. LAC data is latched into the control registers on the +5V to 0V transition of Latch Enable 2. The low level must be held for at least 50 microseconds then brought high for 50 microseconds before any subsequent data changes are made. Ensure that Latch Enable 2 is held high at all other times.

Setting bit 0 true in this word results in a very fast LAC. Use caution for regenerative dynes as this high rate may result in overcurrent shutdown. Fast LAC may be used with discretion to perform complex reference curve generation. Avoid situations where this use may impose drastic electrical/mechanical transients. The LAC data should usually be entered before the next setpoint entry so it is effective for the complete change process. Complex curve generation procedures may require different sequences, and this is allowed. LAC data takes effect as soon as entry is complete.

The equation for Rate of change of set point is:

$$dR/dt=10{,}000/(N+2) \quad OR \quad N=[10{,}000/(dR/dt)]-2$$

Where

- dR/dt = Rate of change of set-point
- N = 8 bit even valued binary number entered by computer
- setting bit 0 = 1 will cause dR/dt=infinite (regardless of other bits)

For RPM mode dR/dt is in units of RPM/sec.

For Torque mode, dR/dt ignores the decimal place and is in LSD units. For example, if your decimal point placement is 0.00, then dR/dt is in units of .01 ft.-#/sec. If 1000/sec is requested for dR/dt, the rate of change of torque reference is 10.00 ft.-#/sec.

5.3.1 LAC Data Entry Procedure

1. Calculate the value of N corresponding to the Rate desired.
2. Convert N to Binary form.
3. Set up this data on the least significant 8 bits of the setpoint bus.
4. Pull Latch Enable 2 bit low, hold for 50 microseconds (filter TC). LAC data is now entered and latched into Dyn-Loc controller.
5. Pull Latch Enable 2 bit high.
6. Hold Data for 50 microseconds (filter TC). Ensure Latch Enable 2 is held high until next LAC entry.

5.4 Parallel Control Port: Entering Setpoints

RPM or Torque setpoint entry data is in BCD form, utilizes a 16 bit data bus, and is latched by a low value on Latch Enable 1.

ENTRY OF A ZERO VALUE FOR SET-POINT IS NOT ALLOWED. This results in a non-regulated condition. Any value from 0001 to 9999 may be entered, but all four BCD digits must be defined at each entry. Avoid entry of a setpoint that may be out of the range of reliable control. For example, requesting an eddy-current control to provide 00.10 ft.-# torque when rotational losses alone exceed this value.

Torque display calibration is done with consideration of the decimal place entered on DIP switches and shown on display. The control circuits are not aware of this situation. They are considering only the Ref/FB frequency relationships. Feedback frequency is the same for 10.00, 100.0, & 1000 Ft.-# conditions (the decimal place is immaterial). When entering a torque setpoint, ignore the decimal place (a request for 10.00 Ft.-# is sent as "1000").

5.4.1 Setpoint Entry Procedure

1. Convert desired RPM to packed BCD format (9999 max, 0001 min value).
2. Output BCD data to setpoint bus.
3. Pull Latch Enable 1 low for 50 microseconds (filter TC). Setpoint data is now entered and latched in Dyn-Loc controller.
4. Pull Latch Enable 1 high.
5. Hold data for 50 microseconds (filter TC).
6. Insure Latch Enable 1 is held high until next set-point entry.

5.5 Parallel Control Port: Changing the MODE

All Mode Control inputs are ACTIVE LOW logic with internal 15K pull-up resistors (but no filters). Computer control mode may be entered only by actuation of the Dyn-Loc COMPUTER PB while the computer I/O port online bit is held low. If online is not pulled low, the Computer PB will not latch this mode. ON-LINE MUST REMAIN LOW CONTINUOUSLY DURING COMPUTER CONTROL. It is not latched. If the controller is in Computer mode (online bit low) and the online bit goes high, control modes will shift to Emergency Stop (high braking) and Master Control.

Computer Control has command over the following modes (Active Low logic).

- F1 – Emergency Stop bit
- F2 – Torque Control bit
- F3 – RPM Control bit
- F4 – Dyne Off bit

These computer I/O bits must be fully defined whenever a computer control-led mode change is made (any time Function Bus Enable bit is brought low). RPM and Torque logic levels should never be held low simultaneously. RPM-to-Torque or Torque-to-RPM mode changes are accompanied by an automatic insertion of whatever reference data has been set up on the 16 bit setpoint bus. This is a built-in hardware function that enables you to make a bumpless mode transfer by simultaneously changing the set point.

5.5.1 Changing from RPM to Torque Control Mode

1. Request the torque data: present torque operating point.
2. If necessary, convert the torque data to 4-digit BCD form.
3. Output the BCD torque data to setpoint bus. Do not latch the data.
4. Set up the function bus data. Assume Normal Operation, leave Dyne ON.
   - F1 =+5V Emergency Stop Command (0V = TRUE)
   - F2 = 0V Torque Control Mode (0V = TRUE)
   - F3 =+5V RPM Control Mode (0V = TRUE)
   - F4 =+5V Dyne Off Command (0V = TRUE)
5. Bring the Function Bus Enable bit low.
6. Wait 50 microseconds. The control is now in Torque mode, controlling at the setpoint entered in step 3.
7. Bring Function Bus Enable bit high.
8. Hold all data for 50 microseconds (filter TC).
9. Leave the Function Bus Enable bit high until next mode change.

5.5.2 Changing from Torque to RPM Control Mode

This is the same as Changing from RPM to Torque Control Mode, except the present RPM operating point data is substituted for torque data and F1 - F4 are as follows.

- F1 =+5VEmergency Stop Command (0V = TRUE)
- F2 =+5VTorque Control Mode (0V = TRUE)
- F3 = 0VRPM Control Mode (0V = TRUE)
- F4 =+5VDyne Off Command (0V = TRUE)

All other steps are identical to Changing From RPM to Torque Control Mode.

5.5.3 Causing a Dyne Off Condition

This is an irreversible mode change by the computer. There is no Dyne On mode command unless it is accessed through the remote port.

1. Set up Function Bus data.
   - F1 =+5V Emergency Stop Command (0V = TRUE)
   - F2 = No Change in Status
   - F3 = No Change in Status
   - F4 = 0V Dyne Off Command (0V = TRUE)
2. Bring the Function Bus Enable bit low.
3. Wait 50 microseconds. The control is now in RPM or Torque mode, controlling at the setpoint entered.
4. Bring Function Bus Enable bit high.
5. Hold all data for 50 microseconds (filter TC).
6. Leave the Function Bus Enable bit high until next mode change. The Dyne Control is now off, and no further engine control is possible
7. Inform the operator the computer is no longer in control of the dyne.

5.5.4 Causing an Emergency Stop Condition

This is an irreversible mode change by the computer. There is no Computer EM-Stop Reset Command.

1. Set up Function Bus data.
   - F1 = 0V Emergency Stop Command (0V = TRUE)
   - F2 = No Change in Status
   - F3 = No Change in Status
   - F4 =+5V Dyne Off Command Logic (0V = TRUE)

   Without Dyne On, there will be no stopping torque possible. On-Line may be set to either high or low level since the computer is essentially out of control at this point.
2. Bring the Function Bus Enable bit low.
3. Wait 50 microseconds. The control is now in RPM or Torque mode, controlling at the setpoint entered.
4. Bring Function Bus Enable bit high.
5. Hold all data for 50 microseconds (filter TC).
6. Leave the Function Bus Enable bit high until next mode change.
7. Dyne control is now in Em-Stop mode and applying high braking Torque to the engine.

5.6 Parallel Control Port: Acquiring Status Bits

Dyne Control Status bits display current conditions in the Dyn-Loc controller. This data will be typically used to check on results of commands as a handshake device or for decision making information. There are 9 bits of dyne control status information. They are continuously available on the Computer I/O pins.

RPM /Torque status: Informs of present control mode.

- +5V = RPM mode
- 0V = Torque mode

Dyne On/Off status: Informs of present status.

- +5V = Control On (Dynamometer Control active)
- 0V = Control Off (Dynamometer Control inactive)

'Active' refers to a condition where the dyne control has its field (in case of Eddy-Current) or armature (in case of static DC) excitation enabled and possesses the possibility to control the dyne.

Load Only status: Informs of present condition on a Motoring Dyne as to whether it has its motoring capability enabled or disabled. This function is performed in Dyn-Loc hardware and is set by the operator after a motoring dyne is in its active state. For unattended operation, it provides assurance that a failed engine will not be forced by the dyne to rotate.

- +5V = Load Only: Dyne Motoring capability disabled
- 0V = Load or Motor: Dyne Motoring capability enabled

Emergency Stop status.

- +5V=control is presently in Em-Stop condition
- 0V=control is NOT in Em-Stop condition

Lock Bit status: Informs of the present status of the control loop. If the lock bit is True, the control is frequency LOCKed. The setpoint is exactly matched by the feedback in either RPM or Torque modes. This bit will be briefly untrue if an engine transient requires a sudden torque change or if a noise pulse causes a false control point shift; therefore, critical decisions should not be based on the value of this bit.

- +5V = Lock condition
- 0V = Not in Lock condition

Overspeed/Underspeed status: Informs of the OS/US safety module's present condition. The OS/US module continuously tests the RPM signal to determine if either of 2 conditions exist.

- Dyne On condition but no RPM signal (this is interpreted as a loss of feedback condition)
- RPM signal frequency exceeds OS module set point

Either of these conditions sets and latches the OS/US bit.

- +5V = Overspeed or Underspeed fault has been sensed
- 0V = No Trip, safe condition

LAC Complete: Informs whether the new setpoint has been reached by the LAC circuit. The LAC circuit changes the reference frequency in a linear fashion at the requested rate until it reaches the setpoint last requested. At that time, the reference frequency becomes stable at the requested value. Whenever this last condition exists, the LAC Complete bit is true.

- +5V = LAC Complete, Reference Frequency is stable
- 0V = LAC in progress, Reference Frequency not yet stable

Computer mode status: Informs whether the operator has actuated the Computer mode, and the mode has been enabled to latch by the Computer On Line bit.

- +5V = Computer mode enabled - computer has control
- 0V = Computer mode NOT enabled - control in manual mode

Control Type: Informs of the type of control connected (motoring dyne control such as DC or a loading only type such as eddy current).

- +5V = Motoring/Loading Dyne connected (4 quadrant)
- 0V = Loading Only type connected (eddy-current)

6.0 Parallel Data Acquisition Port Characteristics

Parallel Data Acquisition can be accomplished via 25 pin D connector if the Dyn-Loc is internally configured to do so. This is unusual. Most Dyn-Locs have the connector used instead as an expansion port. Contact Dyne Systems if you need further assistance.

The Parallel data port is an Intel P8255 using CMOS level definitions. Only RPM and Torque (with sign) data are available via the parallel port.

The data pins are purely outputs. Some filtering may be required on computer inputs to avoid noise effects. Data output is 16 bit Binary format. There is no indication of decimal place in parallel Torque data. This must be provided for in the host application software.

6.1 Parallel Data Acquisition Port Operation

Parallel data is acquired on an interrupt basis. Use a complete handshake for this port. Maximum answer delay will be less than 5 msec.

The parallel Data Acquisition process is as follows.

1. Host sets bit indicating type of data wanted (Speed or Torque.)
2. Host issues DataRequest (actually an edge triggered interrupt to the DS503 CPU Board).
3. Host waits for DataValid TRUE (DS503 CPU has honored the interrupt and outputted the requested type of data).

The following 'pseudo code' summarizes the handshake required by the parallel data port if both sets of data are wanted in sequence.

1. Type bit low.
2. Data Request bit high.
3. 1 Test Data Valid bit.
   - If True, take RPM data.
   - If False, return to 1 Test.
4. Data Request bit low.
5. Type bit high.

6 Data Request bit high.

7 2 Test Data Valid bit.

- If high, take Torque data and sign.
- If low, return to 2 Test.

8 Data Request bit low.

6.2 Using the Remote OCS Connector for Additional Parallel Control Capabilities

Command inputs normally used for the remote control may instead be used for the input of computer commands.

- Any of the listed inputs may be used but use of either OS/US Reset or Em. Stop Reset inputs is not recommended.
- Use of the Dyne On function should be protected in hardware and software especially in the case of motoring dynos.
- The Remote inputs have 25ms TC input filters so these inputs must be held for at least 25ms to cause latching of data.

CAUTION: Do not issue a latch enable bit (as with dedicated control commands above).

Chapter 8

Connector Pin-Out Listings

1.0 Barrier Strip

Pin Name	Description	Input/Output
H2O, I.L.	Water control interlock, N.C.	Logic Input
NU	Unused connection	
OS,US	Triac switch, AC Control	Control Output
F1,F2	Eddy-Current field driver	0-16 A DC output
L1,L2	Up to 277VAC field power	0-20 A AC input
L3,L4*	120VAC/240VAC control power	0.1 A AC input
GND	Earth Ground	Safety Ground

*The Control power input is isolated from the SCR power (computer noise Protection), but these sources must be from the same power line phase pair. If they are not phase matched, the field control is unpredictable.

2.0 Load Feedback MS

Pin Letter	Description	Input/Output
A	+12VDC Strain Gauge excitation	Output
B	-Strain Gauge signal	Input
C	+Strain Gauge signal	Input
D	Gauge Excitation Common/shld.	Output
E	External Feedback	Pulse Input 0-40 Khz
F	External Analog FB/Reference	Input 0-10VDC

3.0 Speed Feedback MS

Pin Letter	Description	Input/Output
A	Mag PU differential signal #1	Input 1-30 VAC
B	Mag PU differential signal #2	Input 1-30 VAC
C	Logic Common/Shield	Input
D	Encoder Direction signal	Logic Input 5VDC
E	Encoder 2, 90 deg. advance	Logic Input Speed/Dir.
F	Encoder 1, Ref. angle	Logic Input Speed/Ref.
G	+12VDC, Encoder Excitation	Output

4.0 Analog Torque Output BNC

Analog output representing torque reading is scalable by opening the unit and making adjustments to the DS105 Board. The factory setting is 1mv/unit.

5.0 Analog Speed Output BNC

Analog output representing speed reading is scalable by opening the unit and making adjustments to DS105 Board. The factory setting is 1mv/unit.

6.0 Four-Quadrant (Motoring Dyno) I/O Sub-D

Motoring Dyno Connections

Pin #	Description	Input/Output	ILV
1	Logic Common	I/O	
2	Wrong Direction logic	Logic Output: +5V true	n/a
3	Clockwise Reference logic	Logic Input: +5V true	n/a
4	+5VDC logic power	Output	
5	Dyne On logic	Logic Output: +5V true	Dyne On
6	Emergency Stop logic	Logic Output: +5V true	not used
7	+15VDC analog power	Output	
8	-15VDC analog power	Output	
9	Composite Error, from loop	Output	Dyno Error
10	Analog Common	I/O	
11	Logic Common	I/O	
12	Em. Stop Command logic	Logic Input: +5V true	n/a
13	Four Quad connection logic	Logic Input: 0V true	n/a
14	Overspeed logic	Logic Output: 0V true	E STOP
15	Start OK logic	Logic Input: 0V true	Enable Inspect

7.0 Parallel Data Acquisition Sub-D

Use of this feature requires a Non-Standard Connection inside the Dyn-Loc. Contact the factory.

Parallel Datacq Connections

Pin #	Description	Input/Output
1	Data Request	Logic Input: +5V true
14	Data Valid	Output: +5V true
8	Data Type	Input: +5V=SPEED
2	b15 (most significant bit)	Logic Output
19	b14	Logic Output
15	b13	Logic Output
6	b12	Logic Output
16	b11	Logic Output

Pin #	Description	Input/Output
17	b10	Logic Output
3	b9	Logic Output
4	b8	Logic Output
10	b7	Logic Output
18	b6	Logic Output
9	b5	Logic Output
5	b4	Logic Output
23	b3	Logic Output
20	b2	Logic Output
24	b1	Logic Output
7	b0 (least significant bit)	Logic Output
21	Torque sign	Logic Output: +5V=Neg.
13	Logic Common	I/O

8.0 Parallel Control Sub-D

Use of this feature requires a non-standard connection inside the Dyn-Loc.

Parallel Control Connections

Pin #	Description	Input/Output
1	b1	Logic Input
2	b0	Logic Input
3	b0	Logic Input
4	b3, MSD BCD Setpoint data	Logic Input: +5V=true
5	b1/b1	Logic Input
6	b0/b0 Bin. LAC data	Logic Input
7	b2	Logic Input
8	b2/b6	Logic Input
9	b3, LSD BCD Setpoint/b3	Logic Input
10	F4: Dyne Off Command	Logic Input: 0V=true
11	F1: Emergency Stop Command	Logic Input: 0V=true
12	LAC Ready status	Output:+5V=True
13	Logic Common	I/O
14	Logic Common	I/O
15	Latch Enable 1 logic	Logic Input: 0V true

Pin #	Description	Input/Output
16	Function Bus Enable logic	Logic Input: 0V true
17	On Line Input (Computer Ready)	Logic Input: 0V=Ready
18	Load Only status bit	Logic Output:+5V=True
19	RPM/TQ status bit	Logic Output: +5=RPM
20	b2	Logic Output
21	Torque sign	Logic Output: +5V=Neg.
22	b2/b2	Logic Input
23	b1/b5	Logic Input
24	b4/b0	Logic Input
25	b3, second BCD Setpoint/b7 Bin. LAC data	Logic Input
26	b2	Logic Input
27	b3, third BCD Setpoint data	Logic Input
28	F3: RPM Mode Command	Logic Input: 0V=true
29	F2: Torque Mode Command	Logic Input: 0V=true
31	Overspeed/Underspeed status	Logic Output:+5V=True
32	+5VDC logic power	Output,20ma max.
33	Latch Enable 2 logic	Logic Input: 0V true
34	Control Type: eddy current/4 quadrant	Logic Output: +5V=4Quad
35	Control loop Locked status bit	Logic Output:+5V=True
36	Emergency Stop status	Output:+5V=True
37	Dyne On/Off status bit	Logic Output: +5V=ON

9.0 Remote OCS I/O Sub-D

Remote OCS Connections

Pin #	Description	Input/Output
1	Torque Logic Command	Logic Input: 0V=Torque
2	Power Freq., LDII only	Output
3	Speed Display Frequency	Output
3	Torque Display signal	Output
4	Remote Enable	Logic Output: 0V true
5	-15VDC	Output
6	Not Used	
7	Master Iamp	Output pull down
8	Computer lamp	Output pull down

Pin #	Description	Input/Output
9	Lamp Common	I/O
10	Lamp common	I/O
11	RPM lamp	Output pull down
12	Torque lamp	Output pull down
13	Absorb Only lamp	Output pull down
14	Em. Stop Reset lamp	Output pull down
15	Remote lamp	Output pull down
16	Computer Command logic	Logic Input: 0V true
17	Dyne Off logic	Logic Input: 0V true
18	Remote Command logic	Logic Input: 0V true
19	Master Command logic	Logic Input: 0V true
20	OS/US Reset logic	Logic Input:+0V true
21	Absorb Only logic	Logic Input: 0V true
22	Em. Stop Reset logic	Logic Input: 0V true
23	Analog Common	I/O
24	+15VDC	Output
25	Remote Reference Frequency	Input
26	Dyne On lamp	Output pull down
27	OS/US Reset lamp	Output pull down
28	Lock lamp	Output pull down
29	+5VDC logic power	Output
30	+5VDC	Output
31	Logic common	I/O
32	Logic common	I/O
34	Torque polarity bit	Output: +12V=+TQ
35	Emergency Stop Command logic	Logic Input: +5V true
36	RPM Command logic	Logic Input: 0V true
37	Dyne On Command logic	Logic Input: 0V true

10.0 RS232 Cable Interconnections

The Dyn-Loc RS232 connector has a non-standard pinout. The following table shows how to connect to a standard 9 or 25 pin host computer's serial port connector.

RS232 Connections

9 Pin Female		9 Pin Female		25 Pin Female
Dyn-Loc End	***Signal Name***	***Computer End***	***Signal Name***	***Computer End***
1	COM(Shield)	5	COM	7
2	RX (Red)	3	TX	2
3	TX (Green)	2	RX	3
4	CTS (Black)	7	RTS	4
5	RTS (White)	8	CTS	5
6-9	COM	N.C.		

11.0 Throttle Controller Interface Sub-D

DTC-1 Connections

Pin #	Description	Input/Output
1	X1 torque frequency	Output
2	Torque sign (1=minus)	Logic Output
3	EM stop = 1	Logic Output
4	Dyne on = 1	Logic Output
5	RPM mode = 1	Logic Output
6	OS/US trip = 1	Logic Output
7	Transmit data	Logic Output
8	Request to send	RS232 Output
9	LOCKed = 1	Logic Output
10	Powered up = 1	Logic Output
11	Logic common	I/O
12	Logic common	I/O
13	Unused	
14	X1 rpm frequency	Output
15	DTC1 EMSTOP = 1	Logic Input
16	DTC1 powered up = 1	Logic Input
17	Unused	
18	Unused	
19	Clear to send	RS232 Input
20	Serial receive data	RS232 Input
21	Unused	
22	Unused	
23	Unused	
24	Unused	
25	Unused	

Note: Unused connections may be used by the DTC-1 when it is connected as a stand-alone unit (not connected to a Dyn-Loc).

Chapter 9

HELP Message Descriptions

1.0 HELP Message Standard Format

The system displays HELP messages in a variety of situations.

- A user operation is attempted incorrectly.
- A user operation fails.
- There is a firmware failure.
- There is a hardware failure.

All help messages are presented in the same manner.

- The POWER displays HELP.
- The Speed displays the HELP NUMBER.
- The remainder of the Speed display and the TORQUE display are used to display any possible additional information.

2.0 HELP Messages by Number

HELP #	Description
0	Requested LAC out of range
1	Speed exceeds max counts limit
2,3	TORQUE exceeds max counts limit
4	Auto Zero not accomplished within time limit.
5	Auto Zero attempted with DYNE ON
6	Auto Span attempted with DYNE ON
7	Auto Zero not possible - offset too large
8	LAC change attempted with DYNE ON
9	Auto Span not accomplished within time limit (under range)
10	Auto Span not accomplished within time limit (over range)
11	Requested Auto Span point too low

HELP #	Description
12	Auto Span attempted with insufficient load
13	Shunt Cal attempted with DYNE ON
14	Requested Auto span point too high
15	TQ CAL operation (AZ or AS) attempted while PAL in Over-Range
16	AS failed due to instability in TQ reading
17	Shunt-CAL attempted while PAL in Over-Range
18	Attempted to use LeverWheels while in COMP mode (typically AS or LAC)
75	Spd interm. ave. buffer overflow
76	Tq interm. ave. buffer overflow
77	E-Squared CheckSum error (normal first time power up new systems)
78	DTC serial port TX Buffer overflow
79	DTC serial port RX Buffer overflow
80	Main serial port TX Buffer overflow
81	Main serial port RX Buffer overflow
82	TQ PAL Buffer OverFlow
83	SPD PAL Buffer OverFlow
84	Unable to Calibrate PAL Ref. Clock
85	80c187 instruction encountered without 80c187
86	E-Squared READY TimeOut
87	E-Squared BUSY Timeout
88	E-Squared READ ADDRESS out of range
89	E-Squared WRITE ADDRESS out of range
90	BreakPoint instruction encountered (executing unused area in ROM)
91	WATCHDOG INTERRUPT (NMI)
92	OVERFLOW (80c186 math instructions)
93	Unused Interrupt trapped
94	Single-Step trapped
95	Divide by 0 (80c186 math instructions)
96	Unused front panel pushbutton combo (trap #1)
97	Unused front panel pushbutton combo (trap #2)

HELP #	Description
98	CALL or JUMP Table index out of range of table entries (trap #1)
99	CALL or JUMP Table index out of range of table entries (trap #2)
100	80c187 Exception: Invalid Operation
101	80c187 Exception: Denormalized Operand
102	80c187 Exception: Divide by 0
103	80c187 Exception: Overflow
104	80c187 Exception: Underflow
105	80c187 Exception: Precision Loss
106	80c187 Exception: UNKNOWN
187	80c187 initialization error
190	CORRUPTED STACK
191	CORRUPTED SEGMENT REGISTER
192	SYSTEM TIMER RECURSION
193	FOREGROUND SEMAPHORE FAILURE
200	Main serial port RX call index out of range
300	Road Load function attempted without 80C187 co-processor
301	Road Load function attempted while using counter channel tq acq
302	Dropped out of COMP,TQ,DON mode while in RoadLoad
303	SoftStart timeout in RoadLoad startup sequence
304	d.p. configuration changed while in RoadLoad
305	Calibration function attempted while in RoadLoad
306	Cannot start RoadLoad while in a PushButton function
307	RLSTART command issued while RoadLoad already started
308	RLSTOP command issued while RoadLoad not started
309	Must have special units code set for RoadLoad operation
310	CoastDown TIMEOUT
500	Floating Point ADD routine called without 80187 present
501	Floating Point SUBTRACT routine called without 80187 present
502	Floating Point MULTIPLY routine called without 80187 present
503	Floating Point DIVIDE routine called without 80187 present

HELP #	Description
504	Floating Point FLOAT routine called without 80187 present
505	Floating Point FIX routine called without 80187 present
506	Floating Point COMPARE routine called without 80187 present
1000	Memory Test failure (address will be displayed)

3.0 HELP Messages by Category

3.1 Normal Operation

HELP 0

Requested LAC units per second out of range (must be from 39 to 5000, inclusive) Set the leverwheels to a valid number and try again.

HELP 1

Speed exceeds max counts limit (the frequency seen at the speed pickup input is greater than 32767 Hertz). Message will disappear when Speed drops to an allowable number.

HELP 2 & 3

TORQUE exceeds max counts limit (the voltage to frequency converter is outputting a frequency greater than 32767 Hertz). Message will disappear when Torque frequency drops to an allowable number.

HELP 4

Auto Zero not accomplished within time limit. The Auto Zero must be successful within approximately 10 seconds or this message is displayed and the old zero setting is retained.

HELP 5

Auto Zero attempted with DYNE ON. Auto Zero is not allowed if the dynamometer is on (able to load or motor) because the active switches are being used for controlling the setpoint and, since the dyne is not in a static condition, it would Zero at an unstable value.

HELP 6

Auto Span attempted with DYNE ON. Auto Span is not allowed if the dynamometer is on (able to load or motor) because the active switches are being used for controlling the setpoint and, since the dyne is not in a static condition, it would Span to an unstable value.

HELP 7

Auto Zero not possible because the offset of the dyne/load cell combination is too great. The instrumentation amplifier cannot be electronically offset enough to compensate for the mechanical offset(s).

HELP 8

LAC (units per second) change attempted with DYNE ON. LAC entry is not allowed while the dyne is on (able to load or motor) because the active switches are being used for controlling the setpoint. LAC change is allowed through the serial port during dyne on.

HELP 9

Auto Span not accomplished within time limit (under range). If the Auto Span cannot be accomplished within approximately 10 seconds and the gain has been set to the lowest possible value, this message is displayed.

HELP 10

Auto Span not accomplished within time limit (over range). If the Auto Span cannot be accomplished within approximately 10 seconds and the gain has been set to the greatest possible value, this message is displayed. If this message is displayed for no apparent reason it may be because the DIP switch under the Torque display (position 1) was left on and the control is trying to Span to 10,000 plus the value entered on the leverwheel switches (see Dyn-Loc Set-Up and Maintenance section of this manual).

HELP 11

Requested Auto Span point too low. The active switches must be set to at least 150 or this message is displayed and the Auto Span request is ignored. Set the leverwheels to a valid number and try again.

HELP 12

Auto Span attempted with insufficient load on load cell (reading below 150 ignoring decimal place).

HELP 13

Shunt Cal attempted with DYNE ON. Shunt Cal is not allowed if the dyne is on (able to load or motor) because the active switches are being used for controlling the setpoint and, since the dyne is not in a static condition, it would Span to an unstable value.

HELP 14

Requested Auto span point too high. This occurs when the value entered for an Auto Span is greater than allowed (32767 ignoring decimal place). *This applies to Auto Spans attempted from the front panel or serial port.*

HELP 15

TQ CAL operation (AZ or AS) attempted while PAL in Over-Range. The Torque reading is beyond 32767 ignoring decimal place. Correct this situation.

HELP 16

AS failed due to instability in TQ reading. The system did not detect insufficient range in d2a settings but still was not able span.

HELP 17

Shunt-CAL attempted while PAL in Over-Range. The Torque reading is beyond 32767 ignoring decimal place. Correct this situation.

HELP 18

Attempted to use LeverWheels while in COMP mode (typically AS or LAC). The system cannot read the leverwheel switches unless the Dyn-Loc is in MASTER mode.

HELP 77

E-Squared CheckSum error. This help number also appears in the hardware related section (9.3.4). It is normal for a new system to show this error as the EEPROM is new and has not been written for the first time, and no checksum has been generated.

HELP 78

DTC serial port TX Buffer overflow. This should not occur as the buffer size has been allocated to accommodate the max possible DTC command string length. However, if the system is used without software handshake and multiple DTC commands are issued sequentially this error could occur.

HELP 79

DTC serial port RX Buffer overflow. This should never occur but could if there is a problem with the DTC or the baud rates do not match and too many characters are received in too short a time.

HELP 81

Main serial port RX Buffer overflow. This will not happen unless the software handshake is not used and massive amounts of data are transmitted rapidly.

HELP 96

Unused front panel pushbutton combo (trap #1). Unless you have pressed more than two buttons at once, this should not occur.

HELP 97

Unused front panel pushbutton combo (trap #2). Unless you have pressed more than two buttons at once, this should not occur.

3.2 Math Exceptions

None of these errors should occur. If one of them is seen, it should be noted and reported to the factory for a firmware evaluation/update.

HELP 92

OVERFLOW (80c186 math instructions) The CPU core (NOT the coprocessor) computation resulted in an overflow from the high order bit of the operand.

HELP 95

Divide by 0 (80c186 math instructions) The CPU core (NOT the coprocessor) tried to perform a division by 0 or the quotient was larger than the destination operand type.

HELP 100

80c187 Exception: Invalid Operation. The coprocessor encountered an opcode and data combination that doesn't make sense.

HELP 101

80c187 Exception: Denormalized Operand. The coprocessor encountered an invalid data format.

HELP 102

80c187 Exception: Divide by 0. The coprocessor tried to perform division by 0.

HELP 103

80c187 Exception: Overflow. The result of a computation exceed the capacity of the size of the data in memory.

HELP 104

80c187 Exception: Underflow. With the precision being used, the result of a computation was not too minuscule.

HELP 105

80c187 Exception: Precision Loss. A computation resulted in loss of precision for the data type in use.

HELP 106

80c187 Exception: UNKNOWN

HELP 187

80c187 initialization error

HELP 500

Floating Point ADD routine called without 80187 present

HELP 501

Floating Point SUBTRACT routine called without 80187 present

HELP 502

Floating Point MULTIPLY routine called without 80187 present

HELP 503

Floating Point DIVIDE routine called without 80187 present

HELP 504

Floating Point FLOAT routine called without 80187 present

HELP 505

Floating Point FIX routine called without 80187 present

HELP 506

Floating Point COMPARE routine called without 80187 present

3.3 Firmware (ROM) Failures

These HELP messages should never occur. In most cases these errors indicate the system is experiencing a problem with noise sensitivity, causing the CPU to ‘lose its brains’. Another possible cause is a firmware error that only shows up under rare circumstances. Please report occurrences of these HELP numbers to the factory for assistance.

The technician should ensure the ROM chips are rated for access time of 70ns or better.

HELP 75

Spd interm. ave. buffer overflow

HELP 76

Tq interm. ave. buffer overflow

HELP 80

Main serial port TX Buffer overflow. This should never happen, as the buffer size has been allocated to accommodate the longest possible return string for all possible commands.

HELP 82

TQ PAL Buffer OverFlow

HELP 83

SPD PAL Buffer OverFlow

HELP 88

E-Squared READ ADDRESS out of range

HELP 89

E-Squared WRITE ADDRESS out of range

HELP 90

BreakPoint instruction encountered (executing unused area in ROM)

HELP 91

WATCHDOG INTERRUPT (NMI)

HELP 93

Unused Interrupt trapped

HELP 94

Single-Step trapped

HELP 96

Unused front panel pushbutton combo (trap #1). Unless you have pressed more than two buttons at once, this should not occur. DID YOU?

HELP 97

Unused front panel pushbutton combo (trap #2). Unless you have pressed more than two buttons at once, this should not occur. DID YOU?

HELP 98

CALL or JUMP Table index out of range of table entries (trap #1)

HELP 99

CALL or JUMP Table index out of range of table entries (trap #2)

HELP 190

CORRUPTED STACK

HELP 191

CORRUPTED SEGMENT REGISTER

HELP 192

SYSTEM TIMER RECURSION

HELP 193

FOREGROUND SEMAPHORE FAILURE

HELP 200

Main serial port RX call index out of range

3.4 Hardware Failures

Below are suggestions for chip replacements that will usually fix the problem. If this does not work, additional troubleshooting is needed, most likely in the area of bad traces on the DS503B CPU board or components associated with the one(s) indicated.

HELP 77

E-Squared CheckSum error (normal first time power up new systems). If this error occurs after the system has been configured for the first time (any operation such as span or zero) then the 93c46 chip is bad, or has been blasted by a CPU crash *(highly unlikely)*. If restarting and re-configuring the system does not solve the problem, replace the chip.

HELP 84

Unable to Calibrate PAL Ref. Clock. Indicates that either the crystal oscillator used as cal reference (IC 20) is bad, or the EPLD used for measuring Speed is bad.

HELP 85

80c187 instruction encountered without 80c187. Either the DIP switch indicating presence of the coprocessor is on and none is present, or the coprocessor is bad.

HELP 86

E-Squared READY TimeOut. Replace the 93c46. If problem persists, replace the CPU.

HELP 87

E-Squared BUSY Timeout. Replace the 93c46. If problem persists, replace the CPU.

HELP 18

80c187 initialization error. Either the DIP switch indicating presence of the coprocessor is on and none is present, or the coprocessor is bad.

HELP 1000

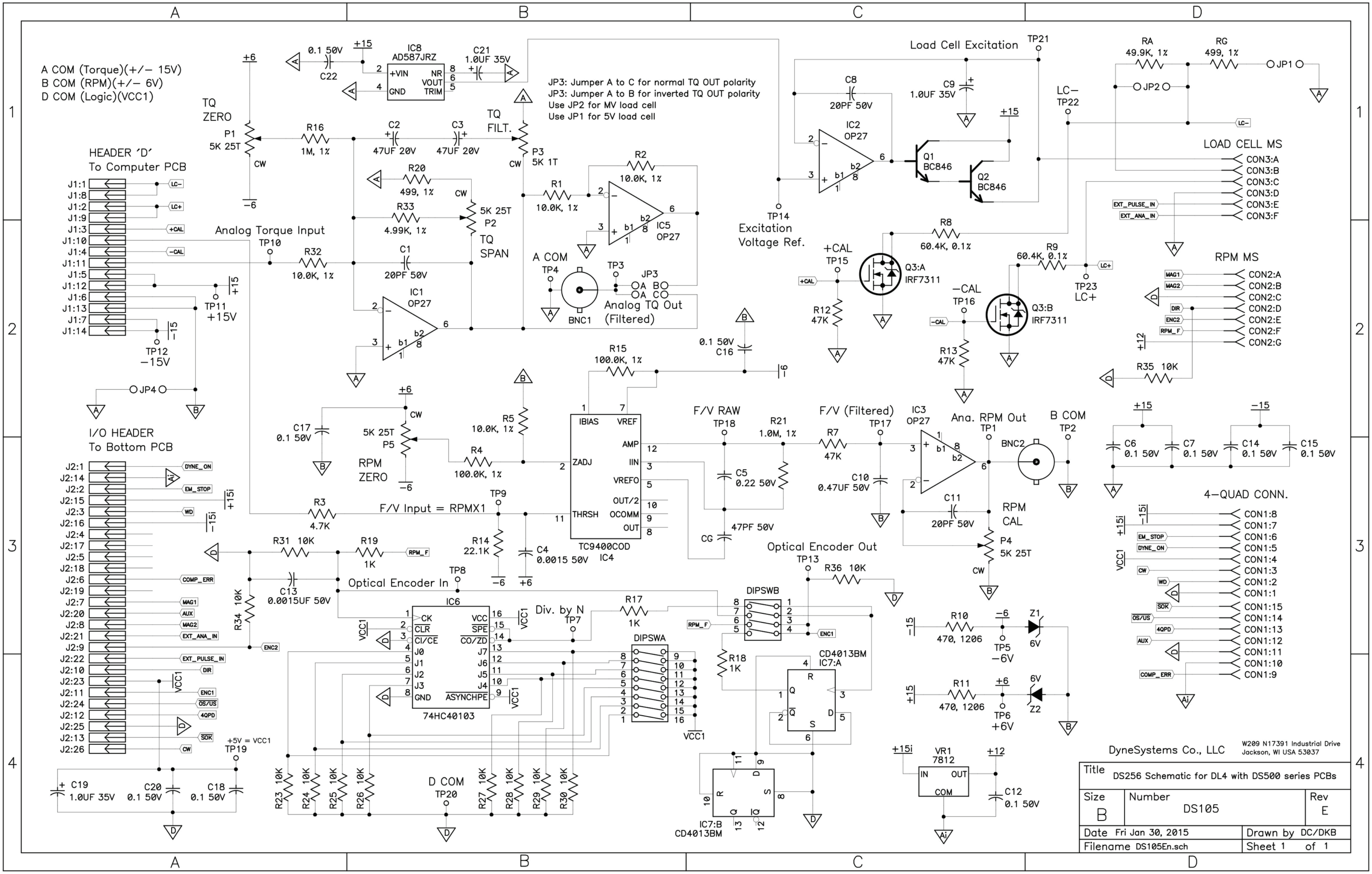
Memory Test failure (address will be displayed). The address displayed is even or odd (of course). IC17 is the even addresses, IC16 is odds. Try replacing the associated RAM chip. Try the CPU. *Are the RAM chips rated at access time of 50ns or better ?*

Chapter 10

Drawings and Schematics

The drawings and schematics in this chapter are listed in the table below.

Description	Drawing#	#Pages	Revision Date
Block Diagram:EC dyno	2 02 025 00	1	06-03-1991
Interconnection Drawing	2 02 002 04	1	07-10-1997
Load Cell Mounting	1 08 006 00	1	03-14-1993
LED Displays/Push Buttons	DS104D	1	05-15-1987
4SCR Reg. Pwr. Amp	DS256A	1	10-10-1988
LeverWheel Switches	CE251A	1	07-24-1984
Overspeed/Underspeed	DS255A	1	07-21-1989
Feedback and 4-quad I/O	DS105D	1	09-07-1994
Push Button - Pilot Light	CE252A/B	1	09-27-1987
Power Supplies	2 10 032 02	1	05-18-2001
Logic & Feedback Rx; VF converters	2 10 018 13	1	05-14-2001
Mode Logic and Lamp Drivers	2 10 018 23	1	05-14-2001
Ref./Fbk Steering Logic and Integrator	2 10 019 13	1	08-31-1998
Ref. Generator/Computer Interface	2 10 019 23	1	05-16-2001
'186/'187, memory, I/O	2 10 020 14	1	05-18-2001
Control Board Interface, DTC-1 I/O	2 10 020 24	1	05-18-2001
Datacq Pals	2 10 020 34	1	05-18-2001
Load Cell interface, a2d conversion	2 10 020 44	1	05-18-2001
Four Quadrant Crossover Regulator PCB	2 10 012 10	1	08-28-1998
	2 10 012 20	1	08-28-1998


A COM (Torque)(+/− 15V)
B COM (RPM)(+/− 6V)
D COM (Logic)(VCC1)
JP3: Jumper A to C for normal TQ OUT polarity
JP3: Jumper A to B for inverted TQ OUT polarity
Use JP2 for MV load cell
Use JP1 for 5V load cell
HEADER 'D'
To Computer PCB
I/O HEADER
To Bottom PCB
TQ ZERO
TQ FILT.
TQ SPAN
Analog Torque Input
Analog TQ Out (Filtered)
RPM ZERO
F/V Input = RPMX1
F/V RAW
F/V (Filtered)
Ana. RPM Out
RPM CAL
Load Cell Excitation
Excitation Voltage Ref.
LOAD CELL MS
RPM MS
4−QUAD CONN.
Optical Encoder In
Optical Encoder Out
Div. by N
DynеSystems Co., LLC
W209 N17391 Industrial Drive
Jackson, WI USA 53037
Title
DS256 Schematic for DL4 with DS500 series PCBs
Size
B
Number
DS105
Rev
E
Date Fri Jan 30, 2015
Drawn by DC/DKB
Filename DS105En.sch
Sheet 1 of 1

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